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JANUARY 1957 VOLUME 31 NUMBER 1

Basic Psychological Factors in Communication

By T. M. HIGHAM

Mr Higham is Chief Industrial Psychologist, Rowntree & Co. Ltd., York. He read this paper at the Twelfth International Congress of Applied Psychology, held in London in July, 1955.

A CELEBRATED authority on Canon law and mediaeval Universities, Dr Hastings Rashdall, was one of those who could ride, but not understand a bicycle. One day, for example, having had a puncture in his front tyre, he was found vigorously pumping up the back one; when a passer-by pointed this out to him, he remarked, "What? Do they not communicate?" I sometimes wonder whether, in our present-day eagerness to 'put people in the picture', we do not behave rather like Dr Rashdall, strenuously pumping in information at one end of a firm, in the hopeful expectation that it will somehow find its way to the other. Perhaps we too ride, but cannot understand.

In the last few years, a great deal has been written on this topic of 'communications', mainly to the effect that communication must be 'two-way', a comment of unstartling originality, as anyone familiar with the derivation of the word must realise. Today you can hardly open one of the many journals, English or American, in the personnel field, without finding some article on the subject, or some review of the latest authoritative work on it; there is even a 'Communications Training Centre' in existence, and one firm, at any rate, now has its 'Communications Manager'; Technical Colleges, Evening Institutes and other organisations run courses in clear expression, and the art of speaking or writing; you can be trained in running a meeting or leading a conference. Training Officers and others make increased use of visual and other aids, as a help in putting their teaching across; industries make use of suggestion schemes, joint consultative committees, broadcast address systems and similar devices to try to ensure that information reaches to all levels in the business and is fed back again to the top. But, as P. H. Cook (1951) has said:

> "There is as yet no firmly-established theory of communication which can provide guiding principles guaranteeing that effective communications will be achieved. As a result much communication practice is dependent on unconfirmed hypotheses, personal hunches and techniques and tricks of doubtful merit."

The nearest approach to a theory of communications has probably come from students of cybernetics and information theory. The new science of 'Communication Engineering', as Professor Meredith (1955) pointed out recently, is so highly developed that "we are strongly tempted to use it as a ready-made frame of reference, and to fit all our ideas about communication into this frame". That I believe to be a mistake—not so much because it is difficult to see what relevance a man-made machine has in considering the problems of a God-made man, but rather because, in everyday life, at home, in industry, in social life generally, the problems of communication (that is, of the transmission of ideas and attitudes) between people and groups are not those which can be solved, or even greatly understood, by means of a knowledge of information theory. Until such time as a machine is developed which can not only interpret information, but also convey its like or dislike of its informant, I believe we should do well to stick to our knowledge of human and animal psychology in trying to understand the problems and workings of communication between individuals and groups.

In most of the studies of communication between individuals and groups which I have come across, scant recognition is given to what is, perhaps, the one fact which we do know from experience about it—that if a person dislikes or mistrusts us, he is not likely to be receptive to what we have to say, and his version of our words is likely to be distorted by his personal opinions of us, or his preconceived notions about our motives. For that reason a study of communication could well begin with an examination of the problems of the reception of information—that process by which we perceive what is said against a background of who says it. It is there that the work of animal psychologists, and the many experimental studies of perception, can help us.

The experiments of Schelderup-Ebbe (1935) with hens, Maslow (1936) with apes, and Lorenz (1954) with dogs have shown clearly that a sizing-up process goes on when two animals meet, which subsequently merges into a dominance-submission relationship. Of these, the most vivid is probably Lorenz's description of the encounter of two adult male dogs.

> "Two adult male dogs meet in the street. Stiff legged, with tails erect and hair on end, they pace towards each other. The nearer they approach, the stiffer, higher and more ruffled they appear, their advance becomes slower and slower. . . . They do not make their encounter head to head, front against front, but make as though to pass each other, only stopping when they stand at last flank to flank, head to tail, in close juxtaposition. Then a strict ceremonial demands that each should sniff the hind regions of the other. Should one of the dogs be overcome with fear at this juncture, down goes his tail between his legs and he jumps with a quick, flexible twist, wheeling at an angle of 180 degrees, thus modestly retracting his former offer to be smelt. Should the two dogs remain in an attitude of self-display, carrying their tails as rigid as standards, then the sniffing process may be of a long protracted nature. All may be solved amicably and there is still the chance that first one tail and then another may begin to wag with small but rapidly

> increasing beats and then this nerve-racking situation may develop into nothing worse than a cheerful canine romp."

Apart from the fact that such encounters take place primarily on a symbolic level, is the encounter between two humans so very different? When two individuals meet for the first time, there is usually a rather more refined process of 'sniffing over'—an interchange of neutral information (the weather, for example, or a search for mutual acquaintances) which serves the same purpose. An attempt to set up a dominance-submission relationship also emerges on some occasions, as Maslow (1937) has shown. Pear (1955) has explored with skill the part played by voice and social differences in the same situation. The fact that this process may be going on below the level of consciousness is a further factor: there are still, for example, some managers who sit with their backs to the light, in a chair just a little higher than that of their visitors, and continue to write after someone enters their office; but luckily their numbers are dwindling. But these, unlike the Admiral's gold braid and the peacock's tail, are more often than not unconscious ways of conveying an impression of importance. None the less, their effect on recipients is much the same.

What has not yet been satisfactorily demonstrated is the opposite of that —the approach or manner which makes for confidence and an easy reception. If there are mannerisms which tend to put the recipients of information in a subordinate position, by conveying an attitude of superiority, are there other ways in which an atmosphere of trust and confidence can be built up without loss of status by either party?

If we recall the two dogs sniffing each other over, I believe we can say that such a situation is possible—and in fact many well-trained interviewers and counsellors are creating such a situation every day. Every interviewer is taught to 'put the candidate at his ease'—in other words to make him receptive, whether it be to questions about himself or to advice and guidance. The exact ways in which this is done vary, but the essential part has been well put by Oldfield (1941):

> "The adoption of an appropriate *general attitude* at the outset of the interview is a matter of greater importance than the maintenance of an effort to *behave* appropriately throughout its course. As an eminent psychologist remarked apropos this question, 'each interview is a world to itself. One hour I am a schoolmaster, the next a parson'."

It seems clear that to ensure good reception, you must create the right atmosphere. This is, perhaps, the one pre-requisite for effective communication. Where it does not exist, communication will be difficult, and all that is said is likely to be distorted. A further complication is that two people, or two groups, rarely if ever meet with what is called an 'open mind'. Each comes together, instead, with preconceived ideas about the other, and about the other's preconceived ideas about them.

During the preliminary 'sniffing over', any small clues that can be fitted into the pre-existing picture will be readily grasped. The ingenious experiments of Asch (1946) demonstrate this point neatly. It will be remembered that he read two lists of personality traits to two different groups of people. The first group's list was 'Kind, Wise, Honest, Calm, Strong'. The second group's list was 'Cruel, Shrewd, Unscrupulous, Calm, Strong'. The last two epithets in both lists were the same. After hearing the lists, separately, the two groups were told, "Suppose you had to describe this person in the same manner, but without using the terms you heard, what other terms would you use?" The first group, who heard the list 'Kind, Wise, Honest, Calm, Strong', gave the following synonyms for 'calm'—soothing, peaceful, gentle, tolerant, mild-mannered. But the second group, who heard 'Cruel, Shrewd, Unscrupulous, Calm, Strong', produced synonyms for 'calm' like cold, frigid, calculating. Similar results were got from the two groups with synonyms for 'strong'—the first group listing such terms as fearless, helpful, just, forceful; the second group giving ruthless, overbearing, hard, inflexible, dominant. Both groups on hearing the first few epithets, got a fixed idea about the sort of person described; the later terms were merely fitted into the existing pattern.

This is not merely an academic point, illustrated by carefully controlled laboratory experiments; it is a very real factor in communication, simply because 'the past in the worker's mind', as Zweig (1952) calls it, is so strong and potent a factor in his reactions. The truth of that is seen in the study made recently by the Acton Society Trust (1952) of communications in the coal mining industry. In an attempt to raise the output of coal, many attempts were made to tell the miners why a higher output was necessary; pamphlets, magazines, even a personal letter from the then Prime Minister, Mr Attlee, were employed. But, as the report makes clear:

> "The mere provision of information . . . does not reduce proneness to prejudice . . . it does not succeed in modifying the underlying attitude of mistrust upon which credulity seems to be based."

In a later report, *Management under Nationalisation,* the Trust (1953) quote the comment of an Area Manager in the Coal Industry, pointing out that he:

> "can never forget that the (Coal) Board's biggest headache is the attitude of the miners and their misconceptions about the work the Board and its staff perform, and, perhaps most important, about the need for economic efficiency."

Then follows the comment of the Area General Manager:

> "We have issued booklets, but nobody bothered to read them. We had a few questions when we started joint consultative committees, but even these have now petered out. We have tried to put explanations into the minutes and put them up on the notice-board, but nobody bothered to read them. It is no use trying to put it over at the lodge meetings of the union, for only a few miners attend them. This is really our major difficulty, how to put this information across and how to rid the minds of the men of misconceptions."

The pathetic notion that you can improve communications by giving more and better information should surely be allowed to die a natural death; you will not get any reception if you are not trusted; but if relations are good, then there is a good chance that what you say will be received, and that you will get co-operation in return.

But even where trust and mutual confidence do exist, that tendency to come to an interview, meeting or conference with preconceived notions is still found, and we cannot afford to forget that the same situation is almost always seen in different ways by different people, depending on their personal capacities, inclinations and background. Zangwill's (1937) experiment on 'Aufgabe' showed the importance of that. Two groups of subjects were shown, separately, a vague, ill-determined ink-blot. They were not told what it represented, but one group was told that it might be like an animal; and the second group was told that it might resemble a landscape. Both groups drew and described what they had seen. The first group all drew cats, rabbits, or similar animals, while the second group drew mountains and hills. The same stimulus confronted both groups, but their preconceived ideas about it determined their reactions to it.

I believe, therefore, that in trying to understand human communication, we would be well advised to study the basic mental processes that underlie so much of everyday human behaviour—the study of perception in particular, and the many experiments on 'Aufgabe' and attitude formation.

But further problems arise. Suppose that a person to whom we wish to communicate something has sniffed us over, asking unconsciously, "Is he friendly, can I trust him?", and decided that he is disposed to listen to us, we still need to know whether what we say will be understood, and if so, whether, at a later date, it will be recalled or repeated accurately. So I would suggest that comprehension and recall are legitimate subjects for research and study when considering human communications.

Both of these, as it happens, have been studied fully in recent years. I should like, therefore, only to point out a few of the researches or experiments which seem to me to throw light on how we succeed or fail in comprehending information and recalling it accurately.

Bartlett (1951) has suggested that one of the chief functions of the mind, when it is active, is 'filling up gaps'; that is, it is constantly trying to link new material into the pattern of older material, in order to make it meaningful. Our minds seem to prefer the simple and regular to the complex and irregular, and to organise what is received into tidy, meaningful bundles. That is why it is so difficult to get a new idea across; for a new idea has to be fitted into the existing structure in the mind, and it is often quite a struggle to do so. A simple demonstration of that difficulty was given by Wertheimer; to give you an example of it, suppose you look at these four words:

MAN TABLE KNIFE CLOTH

You can, without much difficulty, form some kind of mental picture out of them. If I add the word TROLLEY, you can probably fit that in quite easily to your already established picture. But if I now add the words:

SURGEON BLOOD ANAESTHETIC

you will probably have a few puzzled moments before you are able to reorganise the picture in your mind. The meaning of the isolated words changes as the pattern alters, so that the table, once laid for a meal, with a knife handy for cutting a cake, becomes an operating table, with the knife poised over the man who a few moments earlier was sitting down to his tea.

Our mental habits persist and may help or hinder us; they will only do the former if we can link what we have to say on to what our listeners already know; for in that way, the new can be assimilated to the old.

But there is more to comprehension than mental habits; the interest of the subject matter and our own intelligence are also involved. Some idea of the extent of these factors can be seen in two very detailed and careful experiments carried out by the BBC Audience Research Department (1950, 1951, 1952).

The first of these researches was an attempt to assess the intelligibility of a series of Forces Educational Broadcasts; the second was concerned with the comprehensibility of the five minute programme 'Topic for Tonight' which follows the 10 o'clock news. What was particularly striking about both these researches was that they demonstrated that understanding was largely based on intellectual capacity—not perhaps a very new finding, but an interesting one because it showed the extent to which comprehension relies on intelligence. To quote from the report:

> "It would seem that the talk which is couched at a level of difficulty appropriate to the top third of the population can rarely convey much to people of even average intelligence and little or nothing to the backward quarter (of the population)."

But something else came out of the first research too; that was the finding that, apart from intellectual capacity, comprehension was "profoundly influenced by the extent to which (people) are interested in the subject, or have their interest in it aroused. The greater the listeners' interest, the greater their understanding is likely to be, and vice versa." This factor of interestingness was more important for intelligibility than any factor of style, language, and delivery. Certainly, such factors as limiting the number of main points, providing clear summaries, a lucid and lively style, concrete treatment, and the illustration of abstract points all *make for* intelligibility—the research proved that—but they do not *guarantee* intelligibility; they only come into play if the talk is interesting in the first place.

Although these studies are of great value in showing just how complicated a matter it is to get information across that will be remembered with any accuracy, a broadcast talk is not the same as face-to-face contact; there are, unfortunately, to my knowledge, no scientific studies of the intelligibility of personal talks to an audience as compared with broadcast talks. The nearest approach to such an investigation is the series of experiments conducted by Lewin (1947) on the respective values of lectures and group discussion in changing food habits. It will be remembered that the latter proved far more effective because the audience participated in a decision. They were, in fact, 'ego-involved'. I should like to suggest that it is that factor of ego-involvement which lies behind the importance of interest in the subject matter of a talk, which was so well shown in the BBC researches.

Some years ago, I carried out some experiments on the transmission of rumour (Higham, 1951). The method I used was to get someone to recount a short tale to a second person, who repeated it to a third, and so on; each version of the story was recorded on a recording machine, so that a permanent record was available; by those means the successive reproductions could be analysed to see what changes had taken place in the narrative. I used different types of story and different groups of subjects; one day, quite by accident (as I must admit), I made up a short tale about a professor discussing the prospects of his students in their forthcoming examinations; I tried this out on just such a group of his students as might be involved in this sort of discussion. To my surprise, I found that reproduction of the story showed few changes and comparatively small loss of detail, whereas all the other stories produced many changes and a great loss of content with successive reproductions. Applying an appropriate statistical technique, I found that such a result was unlikely to have happened by chance. The explanation was that the students were personally involved in the story; it was about something that affected their interests; and for all they knew it might have been true, or a prophetic warning! Because of this personal interest they remembered it better.

Joint Consultation, particularly through Works' Councils, shows this sort of thing well: matters which management thinks of burning interest are passed by almost without comment; but if an announcement is made that the price of tea in the canteen is going up, discussion is animated and prolonged. People will show most interest in things which concern them personally, or which are linked to their basic needs; that is perhaps why discussion methods seem to be more successful in bringing about change than are formal lectures, for if you take part in a discussion you become involved in it, and it means more to you.

None the less, I think we would be unwise to neglect the importance of the personal factor even in the comprehension of information. For, as many will testify, a good speaker can arouse interest in his audience, even if he breaks every known rule of lecturing. Professor Meredith (1950) has given an excellent example of this in a talk he gave some time ago:

> "I am not a theologian, but I was once privileged to attend, at a week-end conference, a lecture by a professor of theology. It was twenty-five years ago and it is still vivid to me today. The subject was Amos, of whom I previously knew precisely nothing. By the end of the lecture I had not only a dynamic impression of the character and message of the prophet but also a clear and colourful picture of the contemporary economic, political, and social structure of the people of Israel. The professor used no notes. He padded round the room, with his hands behind his back, and wearing felt slippers. From time to time he raised one foot to scratch the calf of the other leg. Now and then he looked at one or other of us directly in the eyes, with a kind of challenging glare. At other times he gazed through the window into the extreme distance, as if looking at Palestine, and describing what he saw, taking our gaze with him. I recall that he pronounced Jahweh with the sort of sound one makes in clearing one's throat."

Later Professor Meredith gives his views on why the professor of theology, and other lecturers he had heard, succeeded in communicating to their listeners. He says:

> "You can wander about, you can indulge in irritating mannerisms, you can hum and haw, you can remain glued to a desk, you can twiddle your fingers, you can commit all the crimes on the statute book (the latter would make entertaining reading if someone would write it: "The Deadly Sins of the Lecture Theatre"), and you can get away with all of them if only you have the one supreme virtue. What is that virtue? The name I would give it is *vitality*. This was the common factor in all my remembered lectures."

I suggested earlier that the recall of information was a part of the process of communication which could well be studied. Indeed it has been thoroughly explored, notably and perhaps primarily by Sir Frederic Bartlett (1932) whose book *Remembering* is still the classic on that subject. Later work by Allport and Postman (1948) and others on rumour has supported these earlier findings. The factors of interest and personal involvement, which I mentioned earlier, are important in recall, because we tend to remember better and more accurately those things in which we have been personally interested; but with matters less personal, or less interesting, our minds tend to transform what we have heard, until our final recollection may be quite different from what actually took place. This is an important factor in two way information, because if, for example, a Works' Council holds a meeting, it is attended by delegates from different sections of the organisation, who have to report back to their constituents; and it is in this reporting back that mistakes and falsifications—albeit involuntary ones—are apt to occur.

Another BBC experiment has shown the importance of some other factors in recall as well. This experiment (1954) was about the immediate memory of a feature programme, one of the 'This is the Law' series, in which the script was enlivened by dramatisation, and by being cast in the form of a continuous story. In addition the subjects were all personally invited to the BBC to take part in the experiment. Under such conditions about 80 per cent of the story was recalled accurately, with the same variations according to intelligence, occupation, etc. as had been found previously. What is interesting, though, is that the material—a connected story, dealing with everyday people and incidents in everyday language—'lent itself to quick and easy assimilation'. But illustrations and dramatisations cannot just be left to make their point; as Vernon has pointed out (1946) they must be related to the subject matter as a whole, otherwise the point is apt to be forgotten.

Here, as in the other aspects of communication which I have touched on, much work remains to be done. So much of what passes for 'communication theory' (in the non-engineering sense) is based on hunches and prejudices that further careful experiments are needed. It is the importance of the personal factor in communication that particularly needs to be examined. Simply because we almost all have to live and work among other human beings, we all tend at times to be like the character in Shaw's 'Fanny's First Play', who was asked to comment on a production. "You don't expect me to know what to say about a play", she said, "when I don't know who the author is, do you?"

If subjective evidence is acceptable, we have the testimony of teachers, sages and others over the centuries, that people tend to weigh up who we are before listening to what we have to say.

St. Thomas Aquinas warned his pupils "Non respicias a quo sed quod sane dicetur memoriae recommenda". Dr Johnson said of someone, "What you have to say about Aristotle tells me very little about Aristotle, but a great deal about you". Emerson put it more forcefully, "What you are sounds so loudly in my ears that I cannot hear what you say". In many speeches, talks, and other forms of communication, it is often the character of the man that shows through the words he uses, as for example in Sir Winston Churchill's war-time speeches. What is said, and how it is said, often matter less than who says it. As Lord Rosebery said of William Pitt the Elder:

> "It is not merely the thing that is said, but the man who says it that counts, the character which breathes through the sentences."

There needs to be some degree of warmth in a personal relationship for real communication to exist. When people in conference or consultation have built up stable and firm relationships, then communication is not only easier but, usually, better. As Sir Geoffrey Vickers (1954) has put it:

> "Consider how much easier it is to communicate on a standing committee, the members of which are used to deliberating together, than on an ad hoc committee which has never met before. Consider also, how, if the atmosphere of a conference begins to deteriorate, all the experienced members will set to work to put it right again, that is, to recreate the mutual attitudes without which it is a waste of time to confer."

So I should like to suggest to you that successful communication will come about by careful placement of key-men—men, that is, who command trust and respect, who are sympathetic and intelligent; they are your eyes and ears, the people through whom information will flow to you and from you. As to most operatives, the foreman, not the Board of Directors, *is* the firm, it means careful selection and training of your supervisors. On a higher level, it means equally careful selection and training of junior staff. But a fundamental attitude of "consistent and fair treatment of employees, pursued in good times and bad, and humour and common sense in day to day relationships", as John Marsh of the Industrial Welfare Society put it recently, is not something you can just lay on; it is not a technique; it springs from qualities of character and personality, which is why selection is so important. As Marsh (1954) says:

> "The fully fashioned personnel or welfare service cannot be effective unless the foreman—who is 'the firm' to most employees—is efficient, just and consistently humane in his leadership. One knows of instances where the results of years of patient endeavour in building up morale have been dissolved within a few hours of a manager losing his temper.

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> All this goes to show that there are no final answers to human relations questions."

And if at times we tend to forget that last sentence, and to think that we really have at last found the means to cure the human ills of industry once and for all—and judging by the rise and fall in the popularity of such means to that end as welfare schemes, joint consultation, communications and co-partnership, at times we all do think that—then we would do well to remember the warning of Sir Thomas More:

> "It is not possible for all things to be well unless all men are good, which I think will not be for these many years."

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Age and 'Paced' Work

By RUTH A. BROWN

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INTRODUCTION

THE problem for older people of 'paced' industrial operations emerged from a survey in industry carried out by Belbin and Sewell (Belbin, 1953). They found evidence that people tended to move away from jobs where the speed of performance is rigidly paced by the machinery used, as in conveyor belt or production line work. These machines are usually set at a speed that is appropriate for younger workers, *i.e.,* the quickest members of a team. Frequently an older person has no difficulty in performing a required operation if he is allowed to do it in his own time, but he seems to find it difficult or impossible when the same operation has to be done in a limited time.

The experiment reported here was done in an attempt to discover the nature of the difficulties that arise in this type of work and at what ages they become apparent.

METHOD

It was decided to use a 'grid-matching' apparatus which had shown a number of age differences in earlier experiments. All subjects had been able to do this task in their own time, but the older subjects adopted a different method which gave a slower but more accurate performance than that of the younger subjects who were quick but made a large number of errors.

The original task has been described elsewhere (Welford *et al.,* 1951) thus:

"The subject was confronted by an apparatus on which was a plate carrying two pieces of graph-paper approximately 6 x 4 inches. The subject's task was to move, by means of a handle, a pointer with a spot on it so as to make the position of the spot on the right-hand piece of graph-paper similar to that of a small steel ball about 1/16th inch in diameter on the left-hand piece, relative to vertical and horizontal co-ordinates on the two pieces.

When the subject thought the pointer was in the correct position he pushed a small button mounted on the handle. If his judgment was correct, the ball started to move about the left-hand grid. If it was incorrect, nothing happened.

The subject went on making attempts until he was successful in making the ball move. He was instructed that as soon as this happened he was to press a key at the side of the apparatus which stopped the ball in a new position on the left-hand grid, and was then to start the cycle of operations over again."

For the present experiment the apparatus was fitted with a timing device that made the steel ball move at a set time interval regardless of whether the subject had made the correct response or indeed any response at all. The task could now be regarded as 'paced' in that the subject was required to respond in a limited time. The cycle of operations was essentially the same as in earlier experiments, but the subject now started with the ball in motion; he then had to stop it and try to locate its position before the machine set it in motion again. If the subject found the correct position a red light came on to indicate that he was correct and he waited until the ball was moved.

Subjects worked at the task for 10 minutes 'paced' and 10 minutes 'unpaced' (*i.e.*, in their own time, as in the original experiment). They were divided into two groups: Group A did the 'paced' task first, followed by the 'unpaced'; and Group B did the tasks in the reverse order. The subjects were taken alternately for the two groups. Numbers and mean ages of those in the different decades are set out in Table 1.

TABLE 1: NUMBERS AND MEAN AGES OF SUBJECTS IN EACH DECADE

AGE GROUPS	GROUP A 'PACED' FIRST		GROUP B 'UNPACED' FIRST		TOTAL GROUP	
	NUMBER	MEAN AGE	NUMBER	MEAN AGE	NUMBER	MEAN AGE
20+	15	22.6	15	22.8	30	22.7
30+	14	34.8	15	33.2	29	34.0
40+	9	43.8	9	44.7	18	44.2
50+	7	53.9	7	52.6	14	53.2
60+	10	64.4	10	64.6	20	64.5
70+	9	74.1	10	74.1	19	74.1

Most of the subjects were skilled operatives and members of junior management from industry. To these were added in the twenties a number of naval ratings of comparable status intellectually. Some of the sixties and all of the seventies were active members of a factory pensioners' club. They were on average a very good group, probably better in health and vigour than the rest.

The subjects were allowed 8 seconds in which to perform the task when 'paced'. This time was chosen as being comfortable for the younger groups, but much shorter than the time taken by the older subjects in the earlier experiments. It meant that, in the 10 minutes allowed for the 'paced' task, the subject had the opportunity of making 75 correct responses. Each stopping of the ball and each attempt to locate its position was recorded on paper moving over a constant-speed drum. Successful attempts and errors were recorded separately, and the latter divided into 'small errors' (very near the correct position) and 'gross errors'.

RESULTS

Effects of 'pacing' on performance: (a) Number of cycles completed

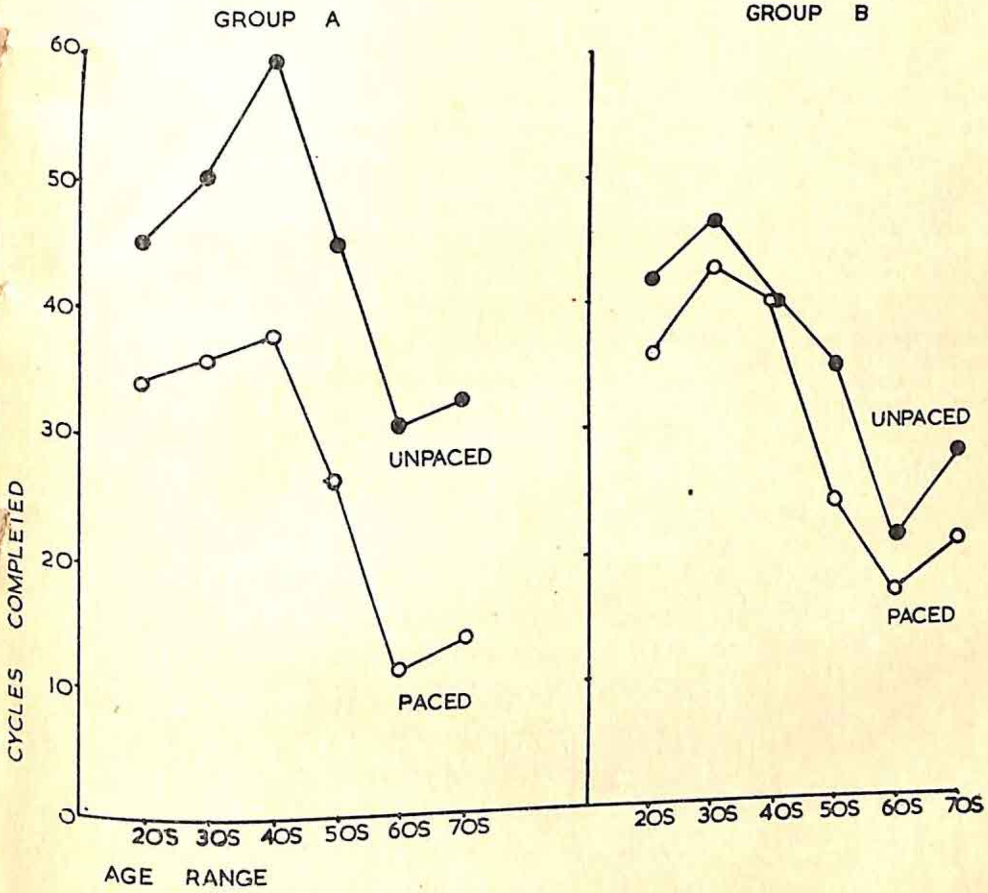

Fig. 1. Average number of cycles completed by each group under each condition.

As shown in Figure 1, the twenties, thirties and forties complete approximately the same number of cycles. There is then a sharp fall off in the fifties continued to the sixties. The slight rise in the seventies is due probably to only the fitter members of that age group volunteering to take part in the experiment.

Group A does the 'unpaced' task significantly ($P<0.1\%$) better than Group B, indicating some positive transfer from the 'paced' task done first by Group A. Comparison of the 'paced' performances of the two groups indicates that the transfer from the 'unpaced' task is also positive on average but very slight.

In nearly every age range in each group, the 'paced' scores are lower than the 'unpaced', significantly so except for the under fifties in Group B, where the difference is masked by the practice effect. The fall in performance in the 'paced' task is both relatively and absolutely greater with the subjects over fifty than those younger (see Table 2).

TABLE 2: COMPARISON OF PERFORMANCE OF GROUPS A AND B ON BASIS OF COMPLETED CYCLES

		20+	30+	40+	50+	60+	70+
Number of cycles completed 'unpaced' less the number completed 'paced'	GROUP A	11.9	14.6	21.7	18.9	20.2	19.3
	GROUP B	−4.7	4.2	0.7	10.6	5.8	7.1
Number of cycles completed 'paced' as a proportion of the number completed 'unpaced'	GROUP A	0.75	0.74	0.65	0.66	0.32	0.36
	GROUP B	1.16	0.98	1.13	0.65	0.75	0.62

The fall with age of performance at the 'paced' task is clearly shown also in other measures set out in Tables 3 and 4.

TABLE 3: COMPARISON OF PERFORMANCE OF GROUPS A AND B ON BASIS OF ATTEMPTS MADE AND TIME SPENT WAITING FOR MACHINE TO MOVE BALL

AGE GROUP	GROUP A	GROUP B
20+	59.9	63.8
30+	59.4	62.7
40+	62.3	63.7
50+	47.9	41.9
60+	27.2	31.3
70+	31.0	37.6

TABLE 4: COMPARISON OF PERFORMANCE OF GROUPS A AND B ON BASIS OF SPARE TIME IN SECONDS

AGE GROUP	GROUP A	GROUP B
20+	53.3	75.5
30+	57.3	90.3
40+	66.6	64.9
50+	42.6	36.0
60+	13.6	23.6
70+	13.7	25.3

The fact that the 'paced' scores are lower than the 'unpaced' is to be expected with *rigid* pacing because, as Conrad (1955) points out, whenever the subject takes longer than the time allowed he fails to complete a cycle, and he wastes time when he completes one too quickly. His overall achievement in a given time is thus inevitably lower than it would be were he performing the task 'unpaced' unless he can do something to speed up the cycles that would normally take longer than the time allowed. Subjects appear to have done this to some extent as shown in Figure 2. The 'expected paced' score was calculated by taking the proportion of cycles completed 'unpaced' in 8 seconds or less and multiplying by 75 (*i.e.* the maximum possible 'paced' score). It thus gives the 'paced' score that would have been attained if the distribution of cycle times 'paced' had been the same as the distribution 'unpaced'. This was calculated for each subject and averages taken for the different age groups. In all age groups this was lower than the 'paced' score.

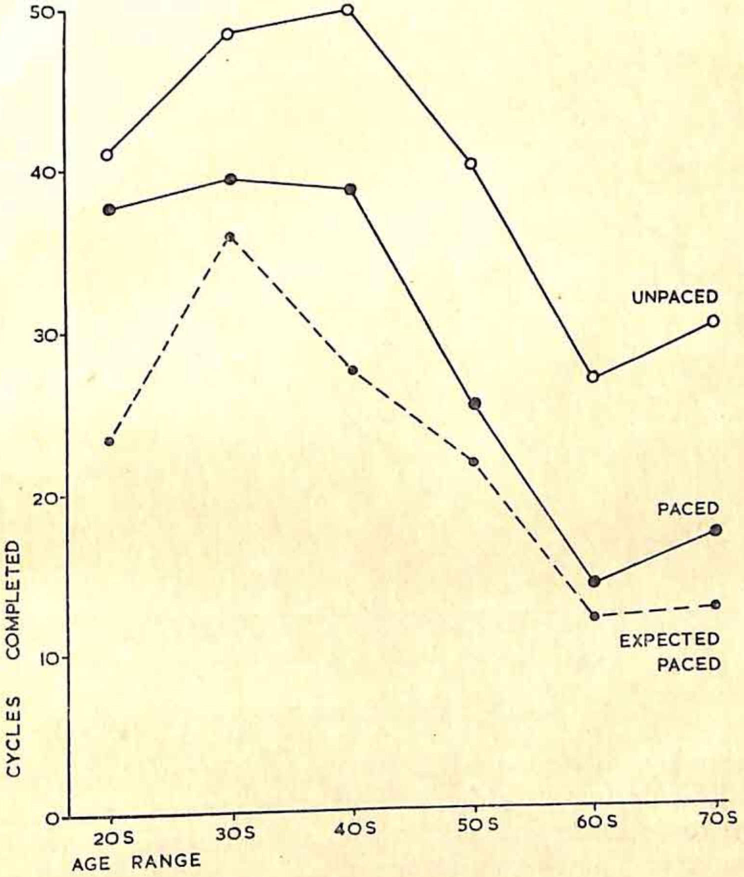

Fig. 2. Average number of cycles completed by all subjects under each condition.

(*b*) *Time to stop the ball*

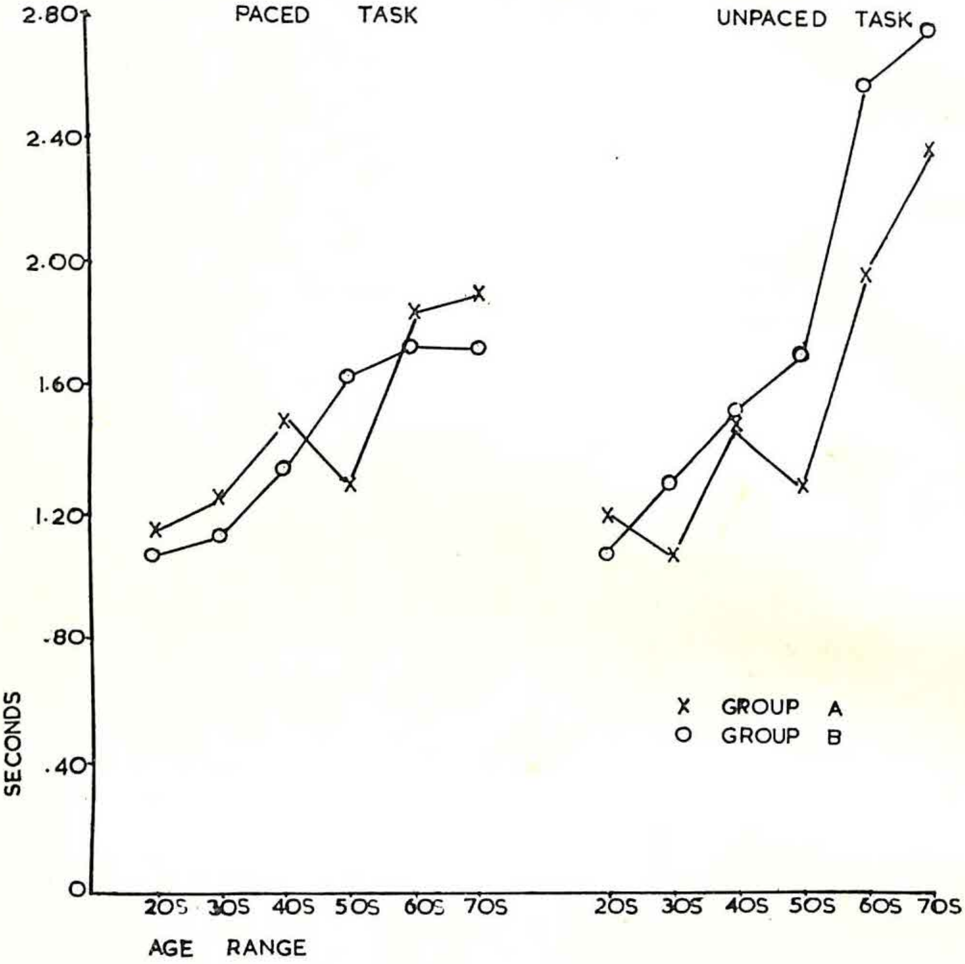

Fig. 3. Average time taken to stop the ball.

The time taken to stop the ball (Figure 3) illustrates one of the main causes of difficulty for the older subjects at the 'paced' task. In previous experiments this measure rose steeply with age and seemed to be used partly as a rest pause and partly as a means of trying to stop the ball in an easy position on the grid, thus shortening the time for the next cycle. As Figure 3 shows, there is a steep and significant rise with age in both groups, and under both conditions. The slope is less steep under the 'paced' condition, but this is not surprising as all subjects were told that the quicker the ball was stopped the more time would be available for locating the correct position. Although this succeeded in speeding up the older age groups on this part of the task they were still not as quick as the younger subjects and were, therefore, at a disadvantage in completing the subsequent cycle. The older age groups appeared harassed and frequently forgot what to do to stop the ball. This forgetting occurred only rarely during the 'unpaced' task. It is interesting to note that it occurred not only among Group A doing the 'paced' task first, but also among Group B who had already done the 'unpaced' task.

(*c*) *Errors*

In former experiments the older subjects tended to give a more accurate performance than did the younger. They were able to do this by spending some time checking before making a response and thus made fewer errors. This resulted in an increase in the time elapsing between stopping the ball and making the first attempt to start it again, and a slight fall in error time. The method was, however, slow and therefore unsuitable for performing the 'paced' task, so that subjects were practically compelled to make a guess at the correct position. This is the usual method of the younger age groups, but it proved very difficult for many of the older people: several of them remarked that they "could not do it without counting the squares" on the grid.

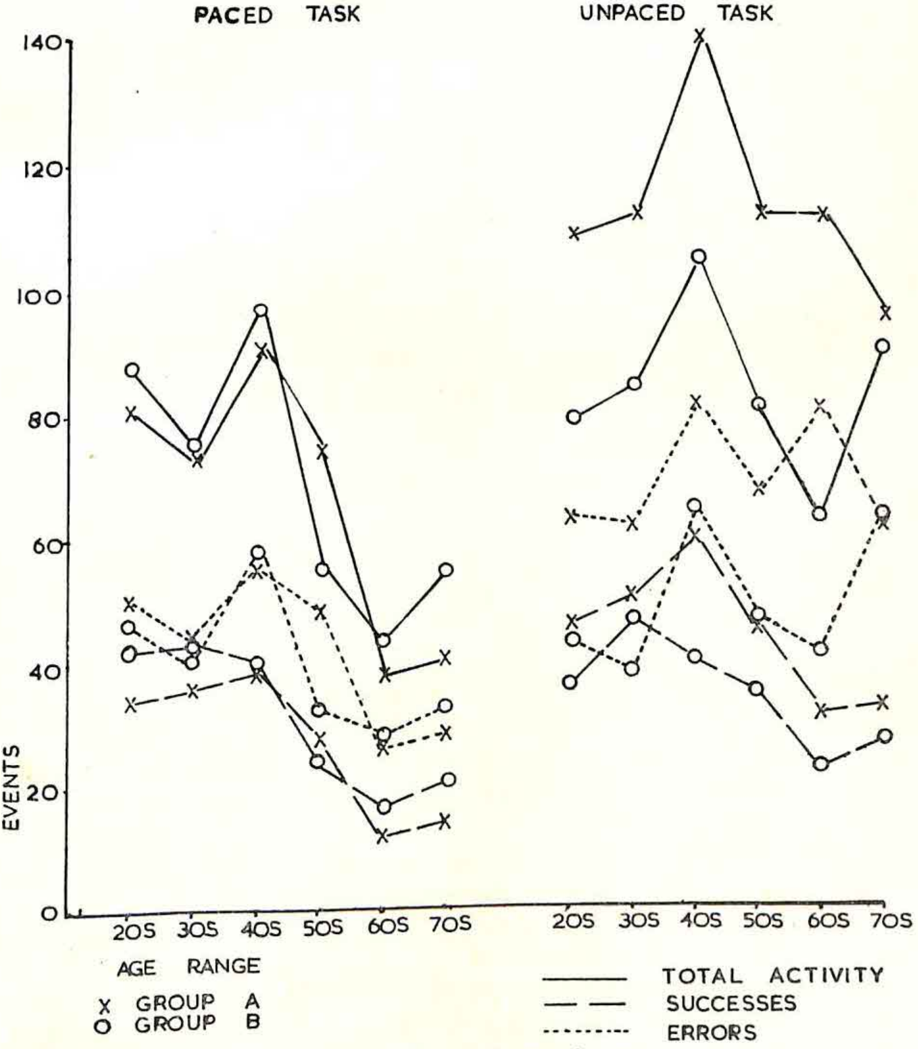

Fig. 4. Average total activity and its components.

From Figure 4, it can be seen that whereas with the 'paced' task the total activity (*i.e.* attempts whether successful or not) of each group is about the same, with the 'unpaced' task Group A is much more active (significant at the 0.1% level), and this is very largely due to the making of many more errors than Group B. It seems likely to have been caused by learning the task under the 'paced' condition, and transferring the guessing method with a consequent increase in errors.

Another deleterious effect of pacing on learning the task can be seen if the errors are analysed into the two different types. The 'small' error is the usual one, just slightly away from the correct position. The other type, the 'gross' error, is made when a subject reads from the edge of the grid instead of from the co-ordinates as he is instructed to do, and is thus a large square out of alignment. In previous experiments this was a relatively unimportant measure as the subjects who made this type of error, once having done so, were unlikely to repeat it because they would try for a relatively long time without success, but eventually realise the nature and cause of their mistake. When, however, subjects perform the task first under the 'paced' condition they do not have time enough to make this discovery and thus have no opportunity to learn to avoid this type of error.

This being so, one would expect Group B to show more improvement in respect of 'gross' errors between the first and second tasks than Group A. The results fully confirm this expectation, improvement being greater in Group B to an extent significant beyond the 0.1% level. Further confirmation is given by the fact that with Group A there is a significant agreement between both halves of the test, those making most 'gross' errors in the 'paced' task continuing to make most in the 'unpaced' task. The improvement in Group B becomes significantly (beyond the 0.1% level) greater with age.

Transition from 'young' to 'old'

It was found in industry that many men moved off 'paced' work around the late forties; numbers working on the jobs concerned were high in the early forties but it was rare to find anyone past the mid-fifties doing work of this type. With almost all scores in this experiment, there was a significant difference between those under fifty and those aged fifty and over. In the figures presented one can see that there is a sharp decline in score at the fifth decade.

Figure 5 gives the total number of cycles completed by the two groups in *both* parts of the experiment together. It will be seen that there is very little difference in overall performance between Groups A and B except for the forties and fifties. Even here the difference is not significant, but it would seem worthwhile to look a little more closely at these two decades as they appear to be especially concerned with the transition from 'young' to 'old'.

The subjects in their forties in both groups and under both conditions give a very active performance and make every effort to maintain the pace: those in Group A, learning the task 'paced' even tend to do better than the younger

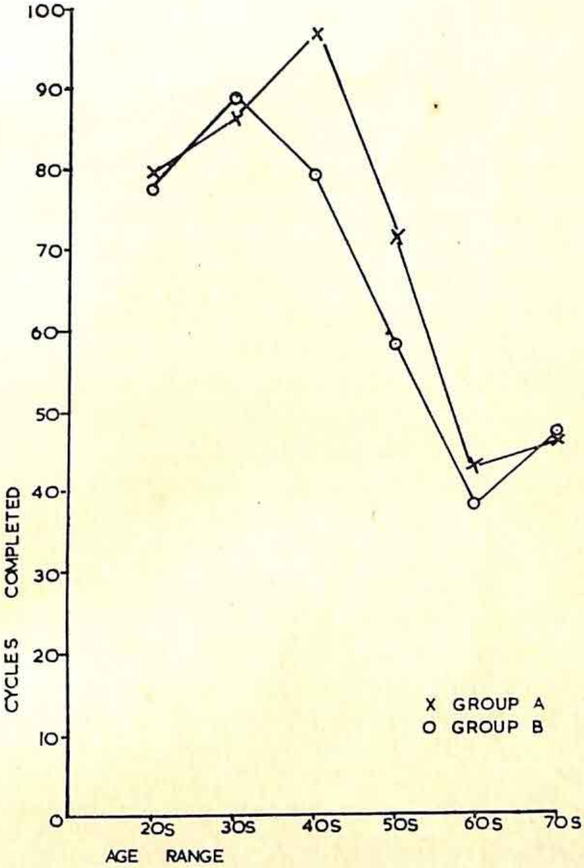

Fig. 5. Average total number of cycles completed in both halves of the test.

subjects. They seem to achieve this at the expense of accuracy, a great deal of their activity is in the form of errors; in fact, the rise in the proportion that is error activity is significant at this age group.

The fifty year olds are affected profoundly by learning the task under the 'paced' condition and in almost all scores Group A did better than Group B. Group B fifties give a performance much nearer to that of the sixties and seventies in all respects; they are much slower and less active than are the forty year olds. Group A fifties tend to fit in halfway between the forties and sixties. They responded to the suggestion that to stop the ball quickly was an advantage in the 'paced' task and were extremely quick, but even this could not compensate for their slowness in completing the rest of the cycle. They also make many more errors than Group B, and this accounts almost entirely for the difference in total activity between these two groups as can be seen in Figure 4.

The fact that 'pacing' seems to have virtually no effect on the overall performance except with these two age groups would seem to indicate that these are the ages that are in the process of changing from the quick, rather inaccurate, method to the slower but more careful method of older subjects.

The scores of those in their sixties and seventies are very similar whichever task they do first. This would seem to indicate that the subjects were working to maximum capacity.

DISCUSSION

It seems possible to make two observations from these results:

(a) That a pace set for men in their twenties and thirties can be maintained in the forties but with an effort which would seem likely in course of time to cause strain. For people in their fifties this appears to be no longer possible. This would account for the requests to move off work of this kind in industry when people reach the mid-forties and why it is rare to find people in their fifties still doing 'paced' work. Many of the young subjects did in fact prefer the paced task because it gave them a feeling of competing with the machine, but this attitude was not adopted by the subjects over forty.

(b) Conrad has pointed out that the attainment of a performance at a paced task comparable with that unpaced is greatly facilitated if there is some latitude in the pacing, so that momentary slowness in one cycle can be redeemed in the next. This is undoubtedly the most important single factor improving performance at paced tasks. In the present experiment no latitude whatever was allowed, but still the subjects gave a performance paced that was better than expected from their performance unpaced. This indicates that a supplementary factor improving paced performance is the speeding up of some of the longer cycle times.

ACKNOWLEDGMENTS

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The Representation of Aircraft By Pictorial Signs

By K. A. PROVINS, H. C. W. STOCKBRIDGE, D. W. FORREST and D. M. ANDERSON

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I: Introduction. II: Description of Choice Experiment. III: Results. IV: Discussion. V: Description of Learning Experiment. VI: Results. VII: Summary and Conclusions. References.

I: INTRODUCTION

EXPERIMENTS in syntactics have dealt with the relationship of pictorial to verbal signs by both learning (Bartlett, 1932) and choice methods (Hall and Oldfield, 1950; Hall, 1951). In these experiments the verbal signs were abstract terms, such as 'philosophy' and 'justice', and the pictorial signs varied from representational to non-representational.

The original purpose of the present experiment was to discover the best set of pictorial symbols to represent the activities of hostile and friendly aircraft; the verbal descriptions used thus differed from those employed in earlier experiments by having highly concrete referents.

Two methods of matching signs to words were tried. First, a choice method produced a series of signs thought to fit the verbal descriptions. This series was then tested in a learning situation (i) against another series not previously matched in this way, and (ii) against a series derived from the subjects' introspections obtained during the matching experiment.

Thus it was hoped to test the following hypotheses:

(1) That more meaningful symbols (as ascertained by the choice method) would be more easily learned than symbols associated with words in a more arbitrary manner.

(2) That a series of symbols based on the subjects' introspections might prove more easily learned than a series based on their actual choices.

The experimental situation also differed from that of other workers. Our subjects in the learning experiment were all drawn from Army units and the testing was carried out in the competitive atmosphere of a group. All subjects appeared to appreciate the possible relevance of the experiment to aircraft tracking procedures.

II: DESCRIPTION OF THE CHOICE EXPERIMENT

Twenty-three symbols had been proposed by various sources as possible visual abbreviations of the following eleven categories of aircraft:

P Friendly—Unknown Category (Friendly aircraft—no further information)

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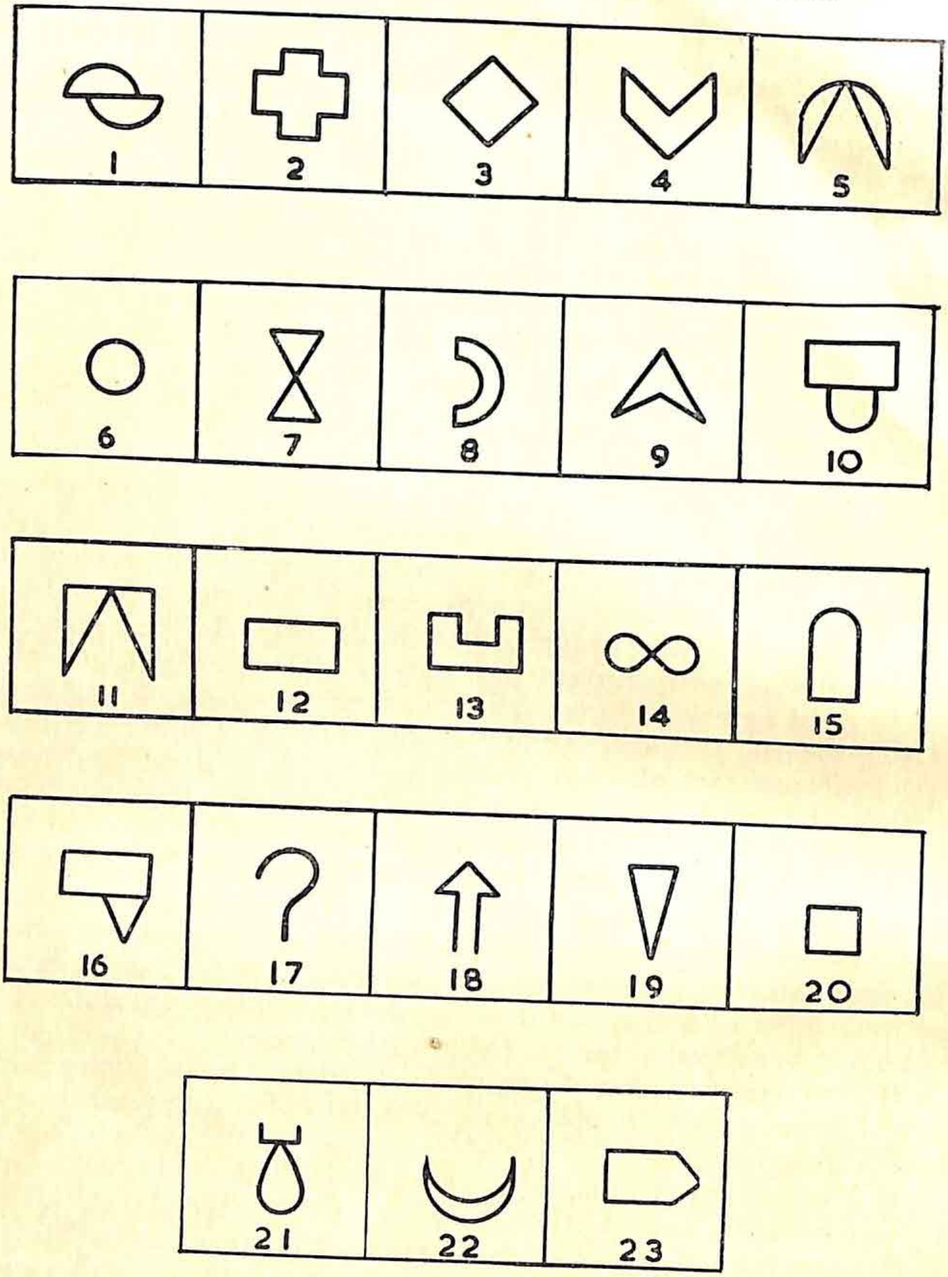

Symbols Presented in Part I
with Identifying Numbers

FIG. 1

V	Stray and special mission (Friendly)
W	Search and patrol (Friendly)
S	Strike (Friendly Attack Force)
R	Homing aircraft (Friendly)
X	Fighter—not available (Friendly)
Q	Fighter—Free to take on Target (Friendly)
Z	Bandit—No action taken (Hostile)
T	Bandit—Being engaged (Hostile aircraft being attacked)
U	Bogey—No action taken (Unidentified aircraft)
Y	Bogey—Being engaged (Unknown aircraft being attacked)

The full set of 23 possible symbols is shown in Fig. 1.

The method used was designed to allow analysis by rank correlation. Ten subjects were employed in small groups of two or three as convenient. Each subject was given a set of cards, on one side of which were typed the descriptions of the categories of aircraft given above, and on the other the identifying letters also given above. The 23 symbols were displayed on separate cards and arranged in a random order of presentation at the beginning of each experiment. The subject was then presented with one of the 23 symbols and asked to rank the set of descriptions in order of merit beginning with the card best represented by the symbol before him, and ending with the description which he associated least with the symbol in question. Thus for each symbol a table of preference was compiled showing the rank order in which the descriptions were arranged by each subject, and the total rankings of each description for all symbols were tested for significance by the method of 'm' rankings (Kendall, 1948), where the number of subjects, m, was 10, and the number of categories, n, was 11.

At the end of the experiment, each subject was asked to comment on any difficulties he had in forming his opinions, and, if he could, give reasons for his preferences in general terms and furthermore to suggest any principles he thought might lie behind such matching whether or not he employed these principles in his own ranking.

III: RESULTS

A summary of the rankings with the results of the tests of significance is shown in Table 1.

The data contained in Table 1, have been compiled from separate ranking tables for each symbol. Each cell therefore contains a figure which is the sum of the rankings for all subjects of the suitability of that particular description for the symbol concerned.

TABLE I: SUM OF RANKINGS IN CHOICE EXPERIMENT

SYMBOLS AS IN FIGURE 1

CATEGORIES	IDENTI-FYING LETTERS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
FRIENDLY (Unknown Category)	P	64	53	64	68	50	50	89	51	83	39	70	37	38	60	38	84	31	74	67	**23**	75	52	66
STRAY AND SPECIAL MISSION (Friendly)	V	42	50	57	54	42	50	55	**35**	52	48	49	50	51	65	45	61	48	57	56	45	50	54	43
SEARCH AND PATROL (Friendly)	W	42	55	31	67	44	56	47	41	49	47	59	30	38	41	59	51	51	47	71	41	55	59	48
STRIKE (Friendly attack force)	S	59	72	66	36	57	78	52	79	23	62	58	74	90	80	63	37	82	**18**	43	85	33	54	37
HOMING AIRCRAFT (Friendly)	R	64	40	46	47	42	47	68	55	75	62	55	**38**	45	37	48	63	79	77	60	35	73	64	39
FIGHTER (Not available, or engaged)	X	78	70	61	70	66	**45**	63	43	79	67	69	61	52	55	51	61	68	65	71	59	79	58	64
FIGHTER (Free to take on target, or not engaged)	Q	79	73	48	49	65	83	60	82	**19**	88	48	70	75	76	73	67	80	35	48	71	63	53	45
BANDIT (Engaged)	T	65	66	75	68	67	80	**40**	81	65	68	45	90	78	64	68	45	86	62	60	80	49	60	85
BOGEY (Engaged)	Y	46	70	75	76	63	81	39	74	69	76	49	89	67	57	69	45	**35**	67	63	83	69	65	80
BANDIT (no action taken, or not engaged)	Z	65	56	64	54	88	47	69	65	73	**48**	73	77	64	70	79	68	65	75	66	73	55	71	80
BOGEY (No action taken, or not engaged)	U	58	55	73	71	76	44	78	54	73	55	85	64	**62**	55	67	77	35	83	55	65	59	71	73
Level of significance attained				.05		.05	.01	.05	.01	.01	.05		.01	.01			.05	.01	.01		.01			.01

IV: DISCUSSION

Of the 23 symbols used, examination of Table 1 shows that 14 of the symbols gave rise to a significant coefficient of concordance ($P < .05$). In other words, for each of these 14 symbols there was significant agreement between the subjects regarding the rank order of suitability of the various descriptions.

Of these 14 symbols, only 11 were required to correspond to the 11 descriptions. So, from the 14 symbols under consideration, the numbers in bold type were selected by inspection, low scores being preferred where possible. The appropriate symbols and corresponding descriptions are shown in Chart A (see Figure 2).

Subjects wrote brief comments on the symbols shown in Figure 1 and these are given below.

Symbol No.	*Subject*	*Comments*
1	R.F.H.	Mystic, suitable for bogey and bandit.
	Dr. H.	Bogey is a very effective word and requires some bizarre shape.
	Mrs. M.	Rounded designs are friendly.
2	D.A.	Black cross for bandit.
3	K.P.	Sharp jagged things are hostile.
	Mrs. M.	Sharp angled designs are fighters or bandits.
4	R.F.H.	Symbols with sharp points are aggressive.
	K.P.	Point uppermost, going out and friendly.
	Dr. H.	A diagram with an apex influences choice in giving a sense of direction or purpose.
	Mrs. M.	Sharp angles to top of page, homing friendly aircraft.
5		No comments.
6	K.P.	Circles are friendly.
	Mrs. M.	v. symbol no. 1.
7	Dr. H.	Being engaged must necessarily have a diagram which is bipartite.
8		No comments.
9	R.F.H.	v. symbol no. 1.
	Dr. H.	v. symbol no. 4.
	Mrs. M.	v. symbol no. 4.
10	H.S.	'Blunt' and 'down'.
11	R.F.H.	v. symbol no. 4.
	K.P.	v. symbol no. 3.
	Mrs. M.	Sharp angles pointing downwards—bandit force.
12	Dr. R.	In many cases, i.e. symbol no. 12, I couldn't get much value out of order of values and feel that many of my results may be random.
13		No comments.
14	K.P.	v. symbol no. 6.

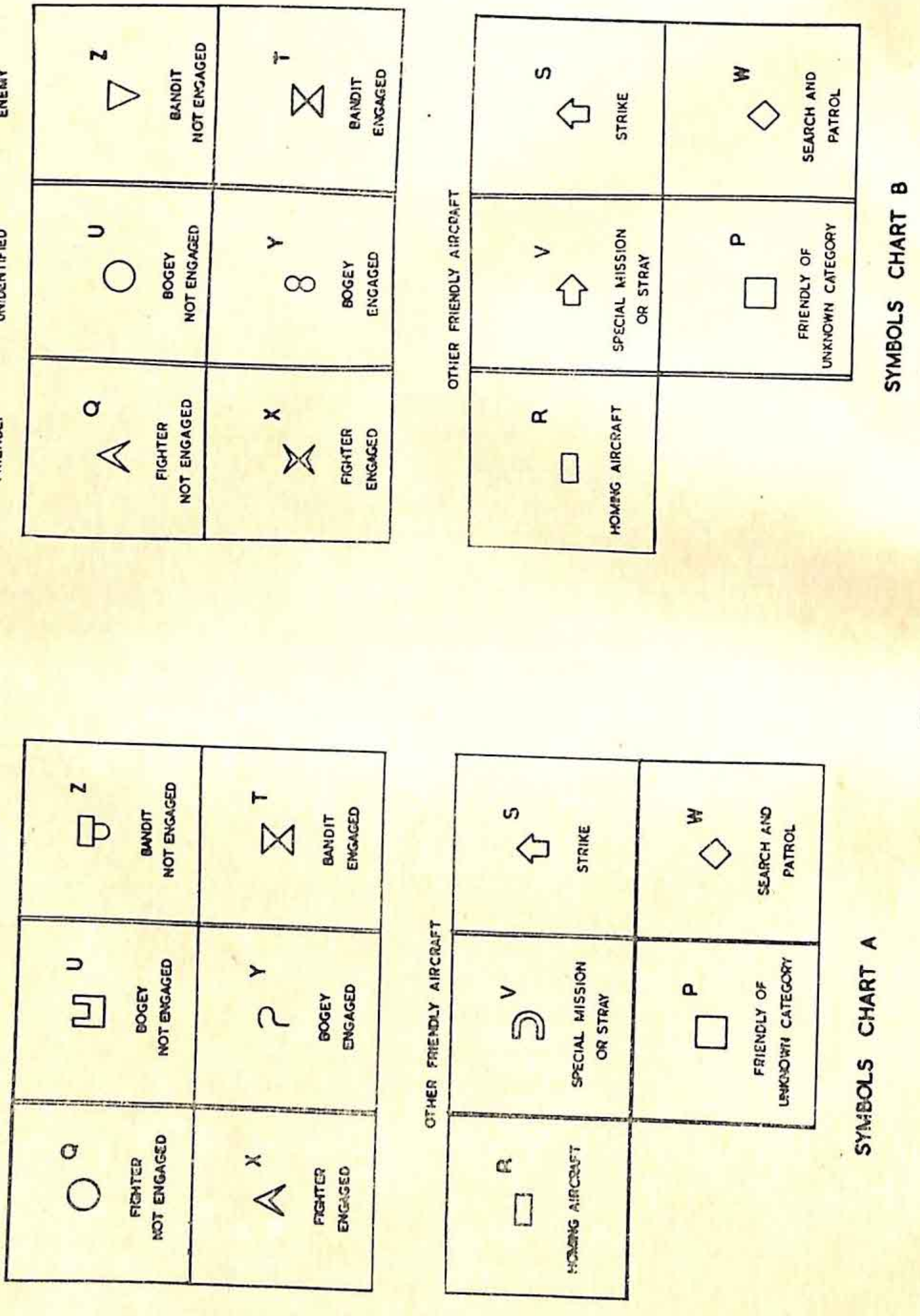

FIG 2

Symbols obtained from experiment I

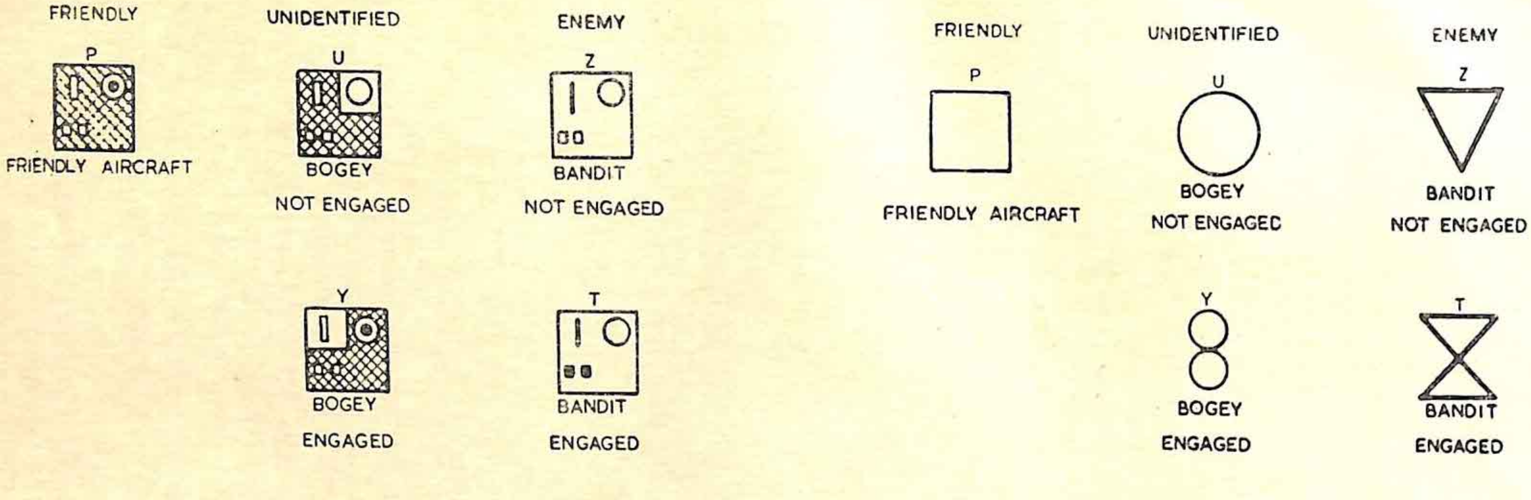

CHART 'C'

CHART 'D'

FIG 3

Shortened Charts, presented in experiment 2, with identifying letters.

Symbol No.	*Subject*	*Comments*
15	Mrs. M.	v. symbol no. 1.
	H.S.	Suggests safety but striking upwards.
16	R.F.H.	v. symbol no. 1.
17	R.F.H.	v. symbol no. 1.
18	R.F.H.	v. symbol no. 4.
	K.P.	v. symbol no. 3.
	Mrs. M.	v. symbol no. 4.
19	R.F.H.	v. symbol no. 4.
	K.P.	v. symbol no. 4.
	Mrs. M.	v. symbol no. 4.
20		No comments.
21		No comments.
22	R.F.H.	v. symbol no. 1.
	Dr. H.	Obviously friendly.
23	Dr. H.	Going somewhere.
	Mrs. M.	Sharp angles to left or right are aircraft on friendly missions.

Examination of the selected symbols and the subjects' notes disclosed certain general principles. These were:

(a) A pointed design suggested a sense of direction or purpose.
(b) A rounded or regular figure appeared to suggest impotence or friendliness.
(c) Downwards pointing symbols apparently gave the impression of moving towards, while upwards pointing designs suggested going away from the subject.
(d) Some subjects thought that 'being engaged' was best represented by a bipartite diagram.

All subjects expressed the view that for each symbol it was easy enough to decide the order of preference for the first two or three descriptions, but that the last four or five in each case were probably chosen at random.

As subjects' introspections appeared fruitful those symbols of the original 23 which seemed best to exemplify these principles were selected and made up into Chart B (Fig. 2). By testing this new chart against Chart A it was hoped to discover whether a matching technique leads to a more easily learned set of symbols than a set derived from subjective impressions.

In a second part of the learning experiment it was possible to compare a shortened version of Chart B (to be called Chart D) with a chart suggested by another establishment (Chart C). This latter chart appears to have been constructed on understandable but arbitrary principles.

V: DESCRIPTION OF LEARNING EXPERIMENT

It was considered that the deductions made from the choice experiment could best be tested in a learning situation on the assumptions that preferred symbols would be more meaningful than the others (Bartlett, 1932; Hall, 1951), and that the more meaningful material would be more readily recalled (Lyon, 1914; Hall and Oldfield, 1950).

The four charts compared were A, B, C and D (Figs. 2 and 3).

One-hundred-and-twenty-three subjects were tested, divided into four groups of about thirty-one individuals so that each group was tested on one chart only. The four groups were balanced as well as possible with regard to age, intelligence and sex. Thirty-eight of the subjects were officer-cadets of the R.A.S.C., forty-eight were officer-cadets of the W.R.A.C., and thirty-seven were officers of the Q.A.R.A.N.C.

The subjects were first given a brief introductory talk by the experimenter to explain unfamiliar terms and the purpose and design of the experiment. They were then divided into their various groups, two groups being tested simultaneously in separate classrooms which were in semi-darkness. Each member of the group was provided with a chart which he was to attempt to learn in a very limited time. Charts A, B, C and D show the symbols exactly as they were given, except no identifying letters or numbers were included. For Charts C and D this initial learning period was 20 seconds in length, and for Charts A and B one minute was allowed, after which the charts were removed.

The symbols were projected on to a screen at the front of the room, one at a time in a random order, until all five symbols in the case of Charts C and D (or 11 in the case of A and B) had been given. As each symbol was displayed for recognition, the experimenter gave its number in the order of presentation (1st, 2nd, 3rd, etc.) and this number was written by the subject on the special answer sheet, opposite the description considered correct.

The detailed procedure was as follows: Each symbol was presented on the screen for three seconds, then removed, and the room lights switched on for five seconds to allow the subjects to write down their answers. The *same* symbol was then displayed a second time for about three seconds and the *correct* description given verbally by the experimenter. The symbol was removed and the lights switched on again for subjects to mark down their own answers. The next symbol was selected and the same procedure followed until all five, or 11 symbols, in the series had been given. The presentation of the whole series was then repeated.

When a subject had completed one correct series, he was asked to remain seated until every member of the group had reached the same criterion.

One objection to this type of procedure with continuous knowledge of results is that the last symbol of a series occupies a favoured position, as there is only one category left 'empty' for it and therefore its correctness is no proof of its having been learned. It is felt, however, that the randomization of the order of presentation would spread this artifact in a random manner among the symbols and can therefore be disregarded.

VI: RESULTS OF LEARNING EXPERIMENT

The scores obtained were examined by means of t tests and analysis of variance.

The raw data were in the form of the numbers of mistakes made on each symbol of each chart by each subject. Before proceeding to the analysis of variance the $\sqrt{k}\,\sinh^{-1}\sqrt{kx}$ transformation had to be applied to the data because of negative binomial non-normality and heterogeneity of variance. After the transformation had been applied, the analysis of variance was completed in the usual way.

Comparison of Charts A and B

Table 2 below is a frequency distribution of the number of presentations of each whole chart for complete learning. Presentation here is used in the sense of a complete cycle of display by the epidiascope and of correction of the answer sheets. Thus column O shows the number of mistakes found in the first corrections of the answer sheets.

TABLE 2: FREQUENCY DISTRIBUTION OF PRESENTATIONS OF CHARTS A, B, C AND D

Number of presentations of whole chart for complete learning:	0	1	2	3	4	5	6	7	8	9	10	TOTAL
Number of Mistakes on Chart A:	136	76	40	39	15	14	20	7	2	3	0	352
Number of Mistakes on Chart B:	172	73	38	19	8	12	4	1	0	2	1	330
Number of Mistakes on Chart C:	38	40	28	18	10	9	4	2	1	—	—	150
Number of Mistakes on Chart D:	113	21	4	2	3	1	1	0	0	—	—	145

The hypothesis tested is that the mean number of mistakes is the same for each chart. Applying a *t* test we obtain a value of 2.12 ($P < .05$). Therefore the hypothesis is rejected; significantly fewer mistakes being made on Chart B than on Chart A.

From the analysis of variance it was found also that Chart B was significantly easier to learn than Chart A, with symbols S and Y being the easiest, and T, P, and Z the hardest to learn within Chart B. A significant difference was found between the individuals within groups of subjects, while the groups themselves were also significantly different, the W.R.A.C. making fewer mistakes than the Q.A.R.A.N.C. who in turn made fewer mistakes than the R.A.S.C.

Comparison of Charts C and D

Table 2 also gives the frequency distribution of the number of presentations of charts C and D for complete learning.

As before, the hypothesis is tested that the mean number of presentations for complete learning is the same for each chart. The value of *t* obtained is 5.03 ($P < .001$), *i.e.* significantly fewer mistakes are made on Chart D than on Chart C.

From the analysis of variance it was found that Chart D was significantly easier to learn than Chart C, with symbol P being the easiest and U the hardest to learn within Chart D. The groups again differed significantly with the W.R.A.C. once more making fewer mistakes than the Q.A.R.A.N.C. and the R.A.S.C.

Chart B

As Chart B and its shorter version, Chart D, appeared to be the most easily learnt set of symbols, a further examination of these charts was attempted. From the users' point of view it was important to establish whether symbols were likely to be confused with one another.

One method of obtaining an indication of this is to construct a correlation matrix as in Table 3.

TABLE 3: CORRELATION MATRIX

	P	Q	R	S	T	U	V	W	X	Y	Z
P	—	—	—	—	—	—	—	—	—	—	—
Q	−0.30	—	—	—	—	—	—	—	—	—	—
R	**0.83**	−0.11	—	—	—	—	—	—	—	—	—
S	0.38	−0.38	0.21	—	—	—	—	—	—	—	—
T	−0.33	0.65	−0.50	−0.65	—	—	—	—	—	—	—
U	−0.18	0.28	−0.33	−0.59	0.19	—	—	—	—	—	—
V	0.74	0.34	0.75	**0.89**	−0.56	−0.33	—	—	—	—	—
W	0.69	−0.30	**0.85**	**0.81**	−0.41	−0.18	**0.87**	—	—	—	—
X	−0.21	0.45	0.00	0.04	0.39	0.57	−0.50	−0.58	—	—	—
Y	−0.26	0.09	−0.02	0.00	0.34	0.34	0.07	0.14	0.65	—	—
Z	0.03	0.41	0.00	0.04	−0.04	−0.10	−0.28	−0.16	0.27	0.10	—

The figures in this table are correlation coefficients between the total number of times any one symbol was mistaken for each of the other nine symbols and the total number of times the other symbol was mistaken for the same nine symbols. A high coefficient might be expected to arise either (1) because there is similar 'confusability', *i.e.,* highly correlated symbols are confused with the other symbols on the chart to a similar extent, or (2) because they are equally difficult to learn. It is clear from an examination of the original mean errors that this second proposition is untrue.

Those correlation coefficients found significant at the 1 per cent level are in bold type in the table. It can be seen that the only symbols which are confused significantly are those for P, R, W, S and V.

Tables given for testing the significance of product-moment correlation coefficients are based on the assumption that the variables are normally distributed. It was known that for these data this was not so, and therefore only significance at the $P<.01$ level was taken into account. Those correlations found significant at the $P<.01$ level by product-moment methods were also found to be significant when ranking methods were used.

VII: SUMMARY AND CONCLUSIONS

In a choice experiment the fitness of signs to words was investigated. From the results two charts were derived: Chart A consisting of the most appropriate of the chosen symbols, and Chart B based on the subjects' introspections and comments. These charts were then tested against each other in a learning situation. A shortened version of Chart B was tested in like manner against a chart based on understandable but arbitrary principles.

The results obtained support the view that the charts composed of more 'fitting' signs (Charts B and D) are learnt more quickly than the others, and point to the fact that the use of a matching technique is not equivalent to the employment of a learning situation.

The authors would like to thank J. Draper for the statistical analysis.

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The Measurement of Musical Aptitude

By HERBERT D. WING

Dr Wing, Principal of the City Training College, Sheffield, read this paper to Section J at the Annual Meeting of the British Association held in Sheffield in September, 1956.

THIS paper comes under the heading of those British Association papers whose purpose it is to make a brief survey of the present position in some field of research in which the author happens to be interested, and to do so in non-technical terms. If in following the recommendation of the President, I omit technical and statistical details which must of necessity be the foundation of any research of this nature, and thereby disappoint some of my listeners, I should like to assure them of my readiness to supply these data in later personal discussion.

It will not be possible for me to do justice to all those early workers in this field, such as Revesz or Helmholtz, nor to express my debt of gratitude to those psychologists, like Burt or Vernon, or musicians like Percy Buck or Cyril Winn, who have given me help and encouragement in the early stages of my research. Instead I am surveying the field by a brief consideration of five tests. These particular tests have been selected from those in present use because each illustrates a somewhat different approach. They are those of Kotick and Torgeson (1950); Farnum (1953); Seashore (1939); Wing (1941, 1954); and Franklin (1956).

In all these cases, as in most psychological work on this topic, the musical aptitude investigated is, as one might expect of psychologists, concerned not with practical performance but with the mental capacity to deal with music. It is generally assumed that this mental capacity must be a forerunner of the capacity to perform music, and there is quite good evidence that this assumption is well founded. Creative aspects of music have so far been left largely uninvestigated, and are likely to remain so until these simpler forms have become better understood. We are, in our present discussion, concerned with all round mental aptitude to deal with musical material. I have, therefore, with some trepidation called this capacity 'musical intelligence' because that term makes the scope of this work clear to the average teacher or administrator.

Interest in this subject is not only of theoretical importance to the psychologist, but is also likely to be of practical use to the teacher and the musician. Indeed my own interest was directed to this particular field because of the practical need to select those children who at the age of 11 might profitably take up the study of an orchestral instrument. Of course, attempts to assess the musical aptitude of young people are not new and have probably been made by practising musicians almost since music began. With the development within the last fifty years or so of the techniques of group mental measurement and of musical recording devices, psychologists have attempted to improve on the musicians' efforts, with, I venture to think, a certain amount of success.

The first test that I wish to mention is that of Kotick and Torgeson. This is a paper and pencil test and nothing is played. It is, in effect, a straightforward paper which might appear in any ordinary examination on musical rudiments. On the first page there are questions on the names of notes (in tonic solfa or number nomenclature) and on tune signatures, while on the second page there are questions on the meanings of musical symbols, on key recognition, and on the recognition of well-known songs written in musical notation. To the musician there is only one advantage in this test over his own examinations, namely, that marking is made very simple by the arrangement of the paper. The answers are registered by making black marks between the dotted lines. The papers may then be marked by stencils, or even by machinery, a process which is very popular in America, but little used here as yet.

Another type of test approximating to the normal musical examination is that of Farnum. This is an American test in which a played tune is compared with the notation. In one bar there is a difference in pitch or rhythm between the notation and the playing, and the child is expected to show the bar in which this difference occurs. In this case, the teacher or other person examining has the advantage that, after the marks have been ascertained, they may be compared with those of other children in the U.S.A. In other words, standardised scores are available. Thus, if a child scores 20 marks and is a girl in school grade 8 (usually age 13), she is about average, being 58 from the bottom in an ordinary sample of 100 girls of that grade, *i.e.*, she is at the 58th percentile. However, there is more than one set of standardised scores given for Farnum's test. There is one for players, one for non-players and a third which combines the two. At least two tables are necessary, because the child who is learning to play a musical instrument has more opportunities to acquire facility with musical notation than the child who is a non-player. To return to our girl of Grade 8 who scored 20 marks: she is well above average if she has had no lessons (74th percentile) and below average (41st percentile) if she has had lessons. Actually each table also provides separate scores for boys and girls. The girls are better than the boys, probably because the girls do more singing in schools. So far, we have been measuring certain aspects of attainment, *i.e.*, what the child has learnt in music. Given equal opportunities to learn, it may reasonably be assumed that the child who is good at music is likely to have a good brain for music, *i.e.*, have good natural musical aptitude. However, equality of opportunity in music is far from the real life situation and so Farnum's test gives results which are bound to be clouded by these inequalities. However, that the test, within its limited scope, has merit is shown by the recent work of Bentley (1956), who places it second in order of merit amongst the five modern tests he investigated.

The Seashore test is comparatively well known to many of you. In this an attempt has been made to get away from the difficulties due to inequality of opportunity by using some basic elements in music, *e.g.* time and pitch, which involve so little acquired knowledge that they measure the native aptitude of the child as distinct from his attainment. There are six tests altogether. In one, for example, the task is to say whether two notes have the same tonal quality. (The note is cow-like in quality, so the problem is to say whether it is the same cow or her sister that you hear!) The instructions and the interpretations of the results are easy. Thus if you had obtained a score of 40 then you would be an average adult. With a score of 50 you would be in the top 10 per cent and with a score of 30 in the bottom 10 per cent. These scores are really another form of the percentiles as used by Farnum. Children are assessed according to their school grades. This is inconvenient if the child is advanced or retarded, so this method is not commonly used in mental measurements in this country, where mental ages and mental quotients or letter grades are usually preferred.

In my own tests, I have, therefore, interpreted the results in the latter terms. For a number of reasons I have also preferred to use testing material which is not too far removed from actual music but is played on the piano, as this is the instrument with which the child is most familiar in school. The style of test I use may be illustrated by a gramophone record which sets the children the simple problem of writing down how many notes are in a chord played. Older children, as might be expected, obtain more right answers than do younger ones. Adults do about as well as 16 or 17 year olds. Reversing the process, if a child of 12 were tested and obtained 9 right he would be as good as an average adult. If he got only 4 right he would be only as good as the average child of 8. With 6 right he would be average for his age. Thus this simple test enables one to give a musical age to a child.

Such a test only takes three minutes to give. Obviously any calculations based on it are likely to be unreliable, partly because a lucky guess or two would change the musical age by a year or so, and partly because of the many facets of musical aptitude that may have been neglected. This point is worth emphasising because there is a certain amount of pressure, by administrators, on test constructors for short and speedy tests. Such 'quickies', as the Americans call them, cannot be reliable and are likely to bring discredit not only to the authors but on psychological testing in general. If it is worth testing a child in order to give him guidance on his future, it appears worth devoting an hour or even more to the process.

Most psychologists in this field would expect, therefore, to use a group of tests which are of somewhat varying kinds. My own preference, out of some 26 with which I have experimented, is for seven. Three are of the simple type already illustrated, while the remaining four involve more complex problems of appreciation. The marks from these seven tests are added together, and the total is interpreted by the use of tables. Thus suppose that a child of 11 obtains 60 marks he is average for his age or of C grade. If he obtains 40 he is in the bottom 10 per cent or the E grade. If the marks are over 80 he is in the top 10 per cent of an average sample for his age or A grade.

A recent test is that of Franklin of Gottenberg, Sweden, who has composed one on tonality which he claims to be reasonably valid. In an earlier form of the test, a child is asked to hum or whistle the end note to a melody. Alternatives are possible, for the first item could be in C major or A minor.

In a later form the melody is supported by harmony which defines the key more closely. Franklin is actually interested not only in measuring musical aptitude, but also in the study of tonality. As with other sciences, however, measurement is often a first step to understanding the nature of that which is measured. This test is of particular interest in view of the lack of tonality of much modern music. Franklin believes that the appreciation of atonal music demands as a prerequisite some sense of tonality or key. He is also interested in estimating which forms of mental activity go to make up mental musical aptitude, so he includes not only other music tests of his own, Seashore and those of myself, but adds vocabulary and intelligence tests of various types. An examination of the results by factor analysis will show which kind of mental activities overlap one another. This is not the occasion to go into details of that nature, especially as Franklin's tables are large and complicated. Instead, I will just illustrate the point by showing some simpler ones of my own which are published in Franklin's thesis. Here it is seen that a common factor occurs in the ability to do the tests which are in the various groups. This factor might be interpreted as a common musical factor, or perhaps 'judicious pitch' following Franklin, or perhaps it might be just ability to pay attention. There is a good deal of scope for individual opinions in interpreting these tables. However, it is interesting to note that Franklin concludes, in comparing his analysis with mine and that of McLeish, that 'there is a considerable measure of fundamental agreement between these analyses'. Such results are, however, at present, of theoretical importance to the psychologist only. It is probably of more general interest to consider those which have a more direct bearing on the work of music teachers and educationalists. They are:

1. Psychological music tests have had a fair measure of success in picking out children of high musical aptitude who might profitably study an instrument. I am thinking here not so much of the musical genius, but of that portion of the population who are likely to get a great deal of fun and interest in life from playing in amateur orchestras, quartets, etc. Apparently, the number of those who fall by the wayside who do well in the tests is extremely small compared with the number who are casualties from the lower group.
2. There is a very wide distribution in musical capacity from the highest to the lowest as is shown by distribution curves, where it is seen that the top 10 per cent of a group of 14 year olds will have the musical understanding of the good, and some of the extremely good, adults, whereas the bottom 10 per cent will have the musical understanding of below the average nine year old. To ask a music teacher to take such a mixed class is equivalent to asking a mathematics teacher to teach Cambridge scholars and morons in the same group. This is hardly likely to happen in mathematics because the morons are in special institutions. The musical morons, however, are left at large. Small wonder that, in these circumstances, music teachers have a bad reputation for discipline, or that the standard reached in musical education is not all that it might be in this country.

It might be argued that the school children are, in fact, not unselected, but that they are divided into various grades roughly corresponding to their general intelligence. This is, in fact, true, but the correlation between general intelligence and musical capacity is, according to my own figures, of the order of .3. In a recent communication from Holmstrom of Uppsala, in Sweden, who uses a slightly modified form of my test, he tells me that from 900 children of 8 years old he obtained a correlation of about .37. This is higher, it is true, but is still of the same order. What does this mean in terms of school organisation? It implies that for the purpose of the music teacher, division by intelligence into groups is only about 6 or so per cent better than it would be by drawing names out of a hat. Obviously, for music teaching, then, if justice is to be done to the teacher and the children, some cross classification is necessary.

3. There is another and very important aspect of this comparative independence between musical aptitude and academic aptitude in so far as secondary modern children are concerned. These children must regard any hope of shining in academic subjects as very remote. The chance to do well in music, however, is very little less than with their grammar school friends. For the right children in the secondary modern school the recognition and development of an aptitude such as music is likely to be of value in developing personality, for it is well recognised that all of us need some direction in which we can do well. However, it is not only for humanitarian reasons that such aptitudes should be discovered and developed, but it is indeed laid down in the 1944 Education Act that it is a legal obligation on administrators to see that this is done. How, I shall leave to them to consider, although psychologists might have some suggestions if consulted.

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The Worker and his Tools

By C. B. GIBBS

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THE process of improving working tools and technologies has been continuous since Man made his first weapons or early flint tools. It has absorbed a large part of his ingenuity, and most of the applied sciences exist to foster this development. The applied psychologist is a comparative newcomer in this field, although he is only continuing, more systematically and with better methods, along a well-trodden path, and he is guided by old ideas.

A fairly well-known story may be recalled here, since it emphasises the first main point I want to make. The basic idea underlying experiments on the design and layout of typewriter keyboards was to improve work output by placing the letters most frequently used under the strongest fingers, and those little used under weaker fingers. The optimal arrangement depends of course upon the structure of the particular language in use. Research showed the practical value of this approach, where machine design is based upon careful preliminary measurement of Man's capacities and limitations. But it is perhaps more interesting and important that further curiosity led to consideration of the question of why the keyboard had been designed so ineffectively in the first case. It was found that the arrangement had followed the traditional layout of printers' blocks, dating back to the Middle Ages. The story goes that this layout, although inefficient for printing English, was excellent for printing Latin, and that this had been its original purpose. It seems that our modern methods of work study may not be so very new.

But applied psychology has the advantage that it should be able to detect the general principles and truths which underlie this and many other examples of the inertia of the human mind. At the present time at least, there are many tools and machines which are relatively ineffective for human use, and for no better reason than that "things have always been done that way". The training and special interests of psychologists may make them a little more aware than others of the blinding effects of habit and custom, and possibly readier to make new applications of old material. The innovator must be aware and highly critical of the mind's limitations, and inventions have often been made by people who are *newcomers* in a field which is outside their main professional interest. We may well believe also that it is a positive advantage to belong to the unpopular class of individuals who are interested in, and adept at, minding other people's business. Quite possibly we should concede that this is the kind of make-up which attracts us to psychology in the first place, and certainly these qualities are soon developed in its practice. But whatever the reasons for the successful entry of psychology into the highly specialised crafts of tool-making, there can be no doubt about the scale and scope of its practical contributions.

About 80 per cent of those graduating in psychology in the United States now enter work which is sponsored by the Armed Services, and many of their problems relate, directly or indirectly, to engineering psychology. Industry is a late starter, both there and in the United Kingdom, but many large concerns already show great interest. Those who enter this field can be assured of great opportunities to make a useful contribution to society.

The methods and aims of this new departure should be clearly defined. The purpose of Man's tools is to lighten his labour, and possibly their most desirable objective is to remove repetition, drudgery and anxiety from work. The logical and primary aim in this field is to help the engineer to replace a man by a machine, whenever these conditions exist and automaticity is possible. The decision to do this is often finely balanced, and must be based upon knowledge of the capacities and limitations of both. My main examples show how certain decisions and control actions which are currently made by men, with indifferent success, might be done more efficiently by a machine.

In this field, irrespective of whether we know it, like it, or accept it, the industrial psychologist is engaged in eliminating much of his own subject matter, *i.e.* certain classes of industrial workers. The consolation, to some at least, is that we might prefer to be psychologists of leisure, rather than of work. But this ultimate objective lies far in the future, and it is usually shown that some combination of man and machine is necessary at present. The next logical step, to the engineering psychologist at least, is to design the tool and machine so that it can be used effectively by most people, with a minimum of special training. The shift of interests and approach in this new departure is well illustrated by this attitude to selection and training procedures. They are certainly still needed for complex man-machine systems, but they appear as a kind of last resort to the engineering psychologist, only to be used if the more direct methods of task simplification have failed. Wherever they exist, one is haunted by the thought that the worker's task should never have been made so difficult in the first place. Consequently, the worker's machines and tools should be designed so that everyday skills and expectancies show high positive transfer to their use.

I cannot attempt any comprehensive review of the many examples and the extensive literature on the subject now available. My few instances may be appropriate because they illustrate the present uneasy stage of transferring some of this work into Industry, from the original sponsors—the Services.

The basic obstacle here is that Industry is not yet aware of the scope and economic value of engineering psychology, which studies the combination of man and machine. Initial difficulties appeared in some work that was carried out on the turning and braking signals of cars. Car manufacturers must try to produce standard types of mass-produced cars, and there is great economic advantage if the signals conform to the regulations of both the home and export markets. At one time, the flashing turning signals of American cars were not accepted here, nor was our semaphore arm type accepted in the U.S.A. It seemed useful to compare the two, on the basis of reaction times, mistaken responses, and their relative value in attracting the driver's attention. The regulations might then be amended, one hoped, in the light of evidence rather than opinion, or the interests of various pressure groups. Considerable differences were in fact found between the signals: it became possible to define the main faults of each, and to suggest some practical improvements. The degree of our acceptance at that time is well illustrated by the fact that amended regulations were issued soon after this report, but so far as could be arranged, they were directly opposed to our recommendations on every major point. The British motoring public was placed in the unenviable position of repeating the psychological experiments on a large scale, and with much greater danger to life and limb. Good, bad and indifferent signals of many different kinds now appear on our roads, and are causing the public concern which could have been predicted reliably from the early experiments. Further experiments are proceeding at Cambridge and elsewhere, but there is now real hope of a happier fate for their findings.

Industry, like the Armed Services before it, is learning its lesson the hard way, but there is no question of our ultimate acceptance. In point of fact there has been a profound change in very few years, and the present difficulty lies rather in meeting the increased demand for advice which is now coming from Industry. The opportunities are great, and it is a matter of concern that no British teaching institution as yet caters for the dual interests of the engineering psychologist. A great deal can and has been done, by psychologists with no special knowledge of engineering and tool-making techniques. But the outlook will be relatively limited until we have more psychologists with wider knowledge of the basic tools, and their relative effectiveness in the hands of Man. Two recent consultations illustrate how work can be simplified by this combination of interests.

One large concern makes extensive use of cranes with grabs, which are lowered into barges to move bulk cargo to a fixed stockpile. The primary concern of management was the difficulty of recruiting, selecting and training drivers, and the fact that the skill was highly specific to the control layout which the men had learned originally. The men objected strongly when transferred to other cranes. Now it is a safe rule that the essential difficulties in controlling a machine can only be appreciated after actually using it, and much of our present trouble lies in the fact that machine designers frequently omit this formality. It was soon found that the driver's task was very difficult, since the grab moved simultaneously in three dimensions, and merged into a dark background as it was lowered into the barge. But accurate judgments of distance were necessary, and the grab movement had to be halted at a critical instant to avoid a lengthy mechanical breakdown. This mishap was common with learners and sometimes occurred with skilled men, so that work was halted in bad visibility, with consequent loss. A suggested solution, which seemed reasonable to all concerned, depended upon the fact that once the barge was in position, the geometry of the situation was fixed. All the relevant operational data could be shown on instruments inside the cab, *i.e.* the two fixed end points and grab movement. The simple task of aligning pointers could be substituted for the difficult task of depth perception. Work would not necessarily halt in bad visibility. Indeed, there would be no particular difficulty in fitting mechanisms which automatically switched off at the predetermined end positions, and made successive sweeps over transport of standard length. The driver's task would then be to set the machine in the first place and monitor it for possible accidents. The machine could do the uninteresting work of repeating accurate point-to-point movements far more efficiently than a human being and with no emotional disturbance.

A similar situation may be noted in many large control rooms of electrical undertakings, where the controller is given vast responsibilities for several inter-connected machines. A crisis may arise when one machine fails and another has to be brought in to take its place. Considerable operational difficulties then face the controller largely because, in present practice, the tidy mind of the engineer usually provides a separate instrument and control panel for each machine. On these are placed the individual emergency arrangements which might be required in a hurry, and recording arrangements which are needed for analysis, but may be dealt with at leisure. This usually results in wide scattering of critical instruments and controls in most control rooms. The consequent emergency sequence is that the controller receives the emergency signal, then carries out visual search and orientates himself before rushing to the appropriate panels to operate the required switches. Advice was given to the relevant designers in the past, with the happy result that they now use some well-tried ideas and seek psychological advice at the stage where it can be most effective, *i.e.* when the proposed layouts are being drawn up.

The probable value of this was demonstrated in a recent examination of a proposed layout. It was noted that the proposed switching sequence on some machines would have been a mirror image of those on others, so that an operator's rapid emergency actions would have been of two kinds, which were completely opposed in space and time. The risks of negative transfer between them, and of expensive—possibly fatal—mistakes, were quite evident to the designer, so that he sought advice. The use of conventional psychological methods might have dictated some elaborate selection and training procedure in this situation, but the first suggested solution, based on engineering psychology, seemed to be an improvement. This was to bring the emergency arrangements of all machines to a central panel where the operator would sit, so that all were within easy range. This would have permitted the use of uniform switching sequences. The less critical arrangements would go to the periphery of vision and action.

A better suggestion followed the realisation that if the failure of a machine can operate a warning signal, it is quite feasible for the signal itself to initiate the emergency action. Automatic sequence switches exist which can bring in different machines and processes in any predetermined sequence. Such things, which the human being does badly, and with much anxiety and stress, could be done better by the tool.

Many similar examples could be given from recent experience. Almost always the engineers were familiar with the devices which were suggested, but in some other context; and many had considerable mechanical inventions to their credit. But this did not necessarily mean that their interests or enthusiasms were directed towards psychological innovation. In all cases—although in differing degrees—the tendency was to adopt the arrangements which were better on mechanical grounds, or which looked more tidy. Common examples are instruments and controls placed close to the machine to economise on connections, and large gaps between hydraulic and electrical instruments to reduce the risk of contamination. Such arrangements may give fractional increases in mechanical efficiency, but sometimes a great decrease in that of the worker, by providing a field of attention which is too extensive. We now have every reason to conclude that the engineer must adopt a wider viewpoint in designing man-machine systems, and that the psychologist can often help him to ease the worker's task.

It is quite possible that the engineer's detailed knowledge and absorption in physical techniques tend to inhibit his capacity to visualise drastic changes in them. When observing the worker and his tools, I have long thought it a great mistake to attend very closely to what people are actually doing, until some thought has been given to what they are really trying to do, and to the range of different possible methods which are usually available.

We should finally consider what the approach may mean to psychology as such, instead of to engineering and industry.

The work on man-machine systems provides knowledge of human limitations and abilities which cannot be gained in any other way, and this is obviously justified on any grounds. The attempts to replace man by machine whenever possible can be justified partly because it is expedient, and it may be an inevitable process. But this appears to be the engineer's job rather than that of the psychologist, and our participation to this extent may need some further justification. To some people this seems to have been in Kelvin's mind when he wrote: "Knowledge which can only be expressed in words is of a meagre and unsatisfying kind." From the earliest times Man has attempted to explain the mechanisms of mind and body, in terms of mathematical models and by analogy with the tools and devices of his age. We should consider whether he can readily, or indeed ever, understand or express the principles which underlie biological mechanisms until these have become familiar in a more simple and open physical environment. There are many examples of common principles to link the physical and biological sciences, *e.g.* self-regulating, and feed-back networks, the principles of calorific measurement and so on. The development of information theory and cybernetics in our own age are only new steps in a long historical process which has made great contributions, and, of course, correspondingly great mistakes. We are trying to describe the most complicated machine on earth when we consider the brain and are forced to go beyond an elementary understanding of physical and mechanical concepts. The modern engineer is producing machines with functions which resemble those of the brain in some respects, and it is now known that in some instances they use similar principles. These models, and the exact terminology which describes them, may give us the tools for further attacks on old psychological problems, but only if we appreciate these common principles.

Somewhat reluctantly perhaps, and notwithstanding all appearances to the contrary, we might well conclude that this approach, in all its aspects, concerns the psychologist even more than the engineer.

The Assessment of the Effects of Training Courses for Supervisors: A Pilot Study

By PETER F. C. CASTLE

The research described in this note was begun and partly completed when Dr Castle was a member of the Foremanship Research Group at the National Institute of Industrial Psychology.

MANY different variables determine the success or otherwise of training in 'human relations', and there are also many criteria of success. The problem of assessing the effects of such training is thus very complex, and it is unlikely that we shall ever reach the point of being able to tell from a controlled experiment whether one type of training is more effective than another. All that we may say is that such and such a course, given under such and such conditions, showed a certain measurable effect and possibly certain other effects which were not measured.

It was pointed out in a previous article (Castle, 1952) that one form of training which is more susceptible of evaluation than most is the Job Relations Programme of Training Within Industry, since it is given in more or less the same way throughout industry and commerce, and being based on a manual depends to a minimum on the skill of the instructor. The article also described a standardised role-playing situation, which was designed to serve as a criterion to measure the effects of training. This note reports the pilot application of this measure to the Job Relations Programme.

EXPERIMENTAL PROCEDURE

The study consisted of a simple comparison on the standardised role-playing test between two groups, each of 18 supervisors, one group having recently completed the Job Relations Programme while the other had never taken it. Any difference in performance between the two groups might be ascribed to the training.

Clearly, the value of any findings from a comparison of this kind depends upon the initial equivalence of the two groups. Care was taken to ensure this, in the following way. The 36 supervisors tested came from three different organisations: 10 from nationalised industry in the Midlands (A), 12 from a large firm in the South of England (B), and 14 from a small firm in the North of England (C).

Within each organisation, A, B and C, half the supervisors comprised the trained group, half the untrained. This division was made differently in each organisation. In A, the whole group consisted of 8 men and 2 women, all of whom were office supervisors. They were divided into groups each of 4 men and 1 woman, thought to be comparable by the executives who knew them. In B, 12 male production supervisors all took the same Job Relations Course. Before training began they were divided into pairs, matched in respect of similarity of work. Then the pairs were randomly divided, one individual in each to be tested before training began, the other after its completion. In C, the 14 male supervisors of a service function were divided into two groups matched in respect of age and supervisory experience. It happened, however, that the firm had decided to train its senior people first, so that the trained supervisors were in every case one grade higher in the firm than their counterparts. Thus the sampling error here tends to favour the trained group over the untrained. (This means that if the trained group performs better than the untrained, it could be because they were a superior group in the first place. If no differences are found between the two groups, then seniority is unlikely to be a significant factor.)

In the standardised role-playing situation, which was used as the criterion, each supervisor interviewed one of his 'subordinates' who had recently been arriving late to work in the morning. The part of the subordinate who was guilty of late arrival was played by the same individual within each organisation, A, B and C. He or she was instructed to aim at consistency between one interview and the next, and generally succeeded in doing this. None of the participants knew at the time that the exercise was to be used to measure the effects of training. All took it seriously, however, and the task evoked a good deal of personal involvement. These precautions ensured that experimental and control groups had an identical task to perform, and that there was no bias due to their trying to influence the results in one way or another.

THE RESULTS

The interview was recorded and later transcribed. It was then rated on five scales (as described in the article referred to):

I. Inquiry into the cause of lateness.
II. Basis of direction.
III. Use of threat.
IV. Sensitivity to worker's response.
V. Tact (independent of the four previous scales).

A five-point descriptive grading was used on each scale.

The mean differences between untrained and trained groups in terms of scale points were as follows:

Scale I: Trained group 0.44 points better than untrained.
Scale II: Trained group 0.23 points better than untrained.
Scale III: Untrained group 0.39 points better than trained.
Scale IV: Untrained group 0.11 points better than trained.
Scale V: Untrained group 0.44 points better than trained.

None of these differences is statistically significant, and all would occur by chance alone once in five times or oftener. On overall score, obtained by summing the ratings on the five separate scales, there is nothing to distinguish the two sets of scores, which are virtually identical. None of the findings then is statistically significant, and the differences between the two groups may be considered for practical purposes negligible.

With such small numbers, this negative result does not permit any far-reaching conclusions to be drawn: it may be that the test is a not sufficiently valid or sensitive measure of supervisory behaviour; it may be that the Job Relations Course had not resulted in any change in the supervisors' behaviour in the situation simulated by the test. What is clearly shown is the need for further research.

ACKNOWLEDGMENTS

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Two Profiles:
The Shop-Steward and The Foreman

By FERDYNAND ZWEIG

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THE SHOP-STEWARD

THE shop-steward is perhaps one of the most interesting, dramatic and constantly evolving figures in the modern works community. His status differs from works to works, even from department to department. It depends not only on the position accorded to him by his mates and the firm, and the general situation, but to a large extent also on himself. He gets as much power as his talents and personality enable him to hold. His position is undefined, as it is comparatively new: in most places it is not older than one generation. Often it emerges from obscurity and then lapses for a time, until some event brings it to the fore. He thrives on conflict between the two sides. When relations are harmonious and smooth, his existence—like a doctor's— is hardly noticed. The firm often backs him up and welcomes his services: at other times it looks at him askance, suspecting ill-will and mischief. He is a product of the firm's attitude to its employees and to him. Every firm breeds its own type of shop-steward, which after certain time is fixed and incorporated in tradition, and is then difficult to change.

The shop-steward is a contact point of many live wires going in different directions. He is the representative of his mates, and as such he must stand firm, assert his authority even to the point of aggressiveness. His mates watch him closely. Is he going to betray them? Is he ready to be tempted by bribes of all sorts? What trust can they put in him? How far should they go? Does he set his personal interest and safety above theirs? Has he courage enough to stick his neck out for them? On the other hand, does he know where to stop, where to call halt before they over-reach their strength? Can they be completely open with him? Is he not a part of management?

But his constituency is actually a generality, and is often divided into many groups which have conflicting interests. He is supposed to look after them all. There may be among them labourers, semi-skilled men and tradesmen. The biggest nuisance are the labourers, who are frequently dissatisfied. He can do little about them. There may be girls in his group. He doesn't know what they want. They always expect you to know everything for them.

But the greatest trouble is his own shop. They always prompt him, and expect from him so many things. But what can he do against his own foreman? He is already in trouble with him. The foreman is eager to show that he is the boss, and he won't stand any nonsense from him. So for his own shop he can do even less than for any other shop. Also, the manager watches him closely expecting of him a great deal: that he should be reasonable, moderate, and not behave like an agitator. He should understand the situation of the management, and not put in fancy claims. He should know all the collective agreements, by-laws and regulations and respect and keep them up, even at the cost of his own popularity. The management expect his co-operation; but at the same time he should carry his mates with him. If he doesn't, his co-operation and good will do not mean a thing. The management, even if the shop-steward is co-operative enough, must pretend that he is not; it must not praise him or boost him. The gap between them must not be bridged openly, otherwise it will compromise him in the eyes of his mates and he will be soon out. So a certain measure of co-operativeness must be blended with the right measure of opposition. But if he makes himself a nuisance—well, the management has a hundred and one opportunities to remember him in case of redundancy or promotion, if not immediately, then later on, when he has ceased to be a shop-steward.

For management, the shop-steward is the main knob for the lines of communication with the floor. Is he really informed about what is going on there? If there is trouble, he is the first to be called to the office. If it comes to that, he is a sort of intelligence agent, and a very useful one at that. But does he speak the whole truth, or does he keep back what suits him? How can they encourage him to speak freely? Who should be encouraged to keep in touch with him? His own foreman, or the personnel manager, or the departmental manager, or perhaps even the general manager? In the latter case would not that turn his head? He would think that he is important, and that would make things worse. A proper balance must be struck between giving him a status and keeping him in his own station. "Times are difficult nowadays," says the manager to himself. "I wish the old times were back, where it was enough to give orders and say 'get on or get out', and not to have to converse with types like that." But the fact is that management is a generality, and of at least three levels; and each level wants him to behave differently. In some places, the foreman is afraid of the higher management, and whenever he wants to achieve something—for instance, to better the working conditions of his section—the foreman may whisper to the shop-steward: "You raise this question at the next meeting of the joint production committee, because I can't do anything about it. But don't say I asked you." In other places the personnel manager has excessive ambitions, and he wants to take all the credit for himself. So he makes complaints look important, inflating the issue and making the shop-steward look awkward. The departmental manager, also, reports on the shop-steward to the general manager; and whenever there is trouble, although he may have given ample warning, the whole blame is put on him. Actually, he is a sort of scapegoat for the middle management. He is a troublemaker. "If only we could get rid of him," they say.

Then there is the Union. The Union say that he should never forget that he is an officer of the Union, although only honorary, or in some cases part-time. He should look after the interests of the Union and serve its cause. He should think not only about his mates, but about the Union as a whole, and that means not only about the present but about the future, and not only about his own members but about the totality of the Union's organisation, with which he has to keep in step. The Union has its traditions and they must be lived up to; and it has its reputation, which cannot be compromised by foolish or irresponsible action. There are always larger interests at stake, because if he brings out his mates, others will have to follow them. So he should be careful. He should not be simply an advocate for his mates: he must be a leader and use his own judgment. The shop-steward is the main line of communication from the Union headquarters to his men. Of course he must be in daily contact with them. But he must keep up his authority; and he must remember that, although his mates have elected him, he owes allegiance primarily to the Union. Actually, he owes his position more to the Union than to his mates. Although the mates have elected him, he was put on the list by the secretary of the local branch, or by the former shop-steward. The Union spotted the man and picked him out from the rest, and if they disapproved of him, they would have a way of getting rid of him. As a collector of dues and subscriptions he is responsible to the Union and gets often a small percentage of the collection. He distributes the pamphlets and Union journal, he informs members about the meetings, about Union policy, about political affairs, about courses and lectures, scholarships and trips. True, nobody is very concerned about these things. Still, it is his job to keep their interest alive at least to a certain extent.

He is not the only shop-steward in the place. In a big place he may be one of 10 or 20 or even 100. His relations with the others are not without conflict and friction. They accuse him of poaching on their preserves. They accuse him of being too co-operative to the management. It is even more difficult for him to get on with other shop-stewards than with his constituency. They all have inflated ideas about themselves, and one regards himself as more important than others. The question of priority is sometimes solved by the importance and prestige of his Union, sometimes by personal prestige, and sometimes by age or security or position. The convener of the shop-stewards' committee is a sort of a boss, senior and co-ordinator who tries to hold all the shop-stewards together.

Up to now we have considered only the problems of the office of the shop-steward. He has, also, personal problems. For he has to look after his own personal interests. He may ask himself: Where does all this lead? Isn't it a blind alley job? They tell me it is the first rung on the ladder, a chance to get out of a drab existence: but is it? In some firms it may be so, he thinks, because they promote their foremen from among the shop-stewards, on a sort of principle, which may be wrong from the point of view of the men represented but which is all the same interesting, immensely interesting. But his own firm has adopted the same principle in reverse. Shop-stewards are always by-passed in promotions. They say they don't want to lose a valuable man in keeping the lines of communication open. Besides this, they say men would resent seeing their representative changing sides, and using knowledge they have entrusted to him for the benefit of the management. Of course, the management say that there are not two sides, or should not be; but what is the use of arguing against common sense and deep seated belief of the workers? The two sides exist and will always exist, as long as there are men who are giving orders and men who have to obey.

What is going to be his position in the future? his wife keeps asking him. "If you stick your neck out, George, they will get you sooner or later, and no one will back you up. They all will be glad, because everyone has a grudge against you for something. I tell you, this job is no good. They say that only the lazy fellow gets himself elected. Look at Peter. He didn't want to stand for this, because he cares for his family. But not you. Since you got this job, you've brought in less money, because you are on time, while others are on piece, and you cannot work overtime. Isn't that laziness, to use your mouth instead of your hands? You've got fancy ideas in your head. And you never have time for your family. Always committeeing. What is the use of all those committees? They never do anything but talk. May be you want to go into politics?" And what if he does? That would be nice, although he doesn't know whether he is good enough. But it would be a good thing to get out of this wretched existence, which is no life at all, although he doesn't know what he would do about his wife because she is not exactly cut out for a politician's wife, is she? She is too vulgar, although quite nice. So she rightly senses that these ambitions have a tinge of 'anti-her'. But those are only dreams which he would never admit or confess to anyone. They appear only on the film of his consciousness in a sort of dreamlife, when he sits with closed eyes in his armchair. But the present situation is full of pitfalls, and he has to keep all his wits about him. The truth is that he is pulled backwards and forwards and in all directions by so many people. Those frustrations, can anyone stand them? All the time he has to watch and watch, until those grievances are tackled, and in the meantime it's all against him. He should wear not one mask, but several masks, one smiling, one grinding his teeth, one looking down, and one looking up. His greatest problem is to change from one mask to another, and still remain the same. Well, somehow he will manage, if only his wife and his friends will leave him in peace. The trouble is that they won't.

A successful shop-steward often becomes a general factotum for his constituency, having a finger in every pie in his district. An outstanding example of this was an ordinary labourer in the yard in an engineering works who was a shop-stewards' convener both on account of his age and his integrity and prestige, and who had a seat on every single committee in the district which had workers' representatives. He put it in his own words: "I am the Chairman of the Shop-stewards' Committee, a Member of the Trades Council, of the Labour Party Local Committee, of the District Committee for the Unions, of a Government Transport Committee for the Region. I am on the Local Council, on the Local Council for Consumers. I am also President of the Union Branch, and a Member of the Joint Production Committee in our firm. I feel very important. But my wife deflates me. She says it is all rubbish and she can't see any good coming from so much talking, and may be she is right. But all the same I work overtime every Saturday morning to pay for her television, and I am nearly sixty. I find the best thing is to use humour in everything, on the Committees and when dealing with men on the floor. Let them have a laugh. Their life is sombre enough."

A foreman, a former shop-steward, has put the qualities of a good shop-steward in this way: "I will tell you what makes a good shop-steward. First of all a good manager, a good job, a good Union and good members. Don't run away with the idea that a good shop-steward can be good by himself. He needs support all around him, as we all do, but most and foremost from the understanding manager, who must realise that he is doing a most useful piece of work for the Company. He expresses what is unexpressed, vague and often half-realised but what can be a real spoke in the wheel. He dispels shadows, ghosts and phantoms: and when he behaves awkwardly, it may only be that he knows no better, because he has had little education and a different code from that of the manager. To understand his troubles with sympathy is half of the battle."

THE FOREMAN

The crucial and most important figure in the battle for production, and the key to work satisfaction and good labour relations, is the foreman. But he is often the most disappointed man in the works. The whole modern trend of specialisation of labour moves against him. His functions are all parcelled out to somebody else. He is the classical example of modern times of the paramount importance of combining the technical need for specialisation with the human need for integration. In the last resort specialised functions must come back to the foreman for that integration. But at present this is rarely done.

The foreman is the bridge between two worlds and he does not know actually to which he belongs. The manager pats him on the back and says: "You are the management"; but the more they pat him, the more distrustful he becomes. Why should they keep telling him just now that he is management, when he has lost most of his rights and functions? They wouldn't say so much about it if it were true. He has a foot in two camps, so perhaps it is important that he should not be 'management', but a 'go-between'. The manager says, "You are management, and you have to consider yourself as management, but . . ." And how many 'buts' there are. The most important is that he should carry the trust of the operatives of whom he is in charge, and that he should be able to carry them with him. But is that easy? Who among the operatives would identify himself with a representative of management? And what would the management say if he lost his gang, lost their confidence, their trust, their good will? He would disappear into thin air, and all the backing of management would do him no good.

So is he a worker, merely one of many? True, he came from their ranks. No foreman ever came from the boss class, he would say, although they try to do it now, as a sort of training for higher positions. A true foreman, one who will remain such all his life, comes only from the rank and file, working himself up the hard way, the sweating way. And it is late in the day when he becomes a foreman, and he doesn't know how long he'll stay one. Once he is out of a job here, it will be difficult for him to get a foreman's job somewhere else. Foremanship is not a certified profession which you can carry with you from firm to firm. It may be in the building industry, where they move with a gang of their own; but not in factories. How many foremen he has seen who came back to the floor. They had to forget all about their foremanship, and to swallow the indignity of being once again mere factory hands. Not that it matters very much. Some men on piecework, earning proper overtime rates, can earn more than foremen do.

And why should the management be so concerned with raising the status of foremen, if they don't pay them as they should? They say, "You have a cushy job. You don't work with your hands, and you don't sweat." But the responsibility? Before he was a foreman he could close his eyes when in bed and forget all about his job. Now the job goes round and round in his head, and he has to make plans for tomorrow. And all these calculations, keeping records, providing materials at the right time, and constant wrangling with time-fixers, inspectors and chasers. He has to take the blame for them, without being able to influence them. They do whatever they think fit and he has to drain the cup.

The other argument is that he has greater security in his job. True, he is not on the clock, although he is not a monthly-salaried man. He is not paid by the hour, but by the week, and even when sick he draws his pay. But now-a-days that does not amount to much. When redundancy comes, he will be out like the rest of them, and when there is no work to be done, all are in the same position.

Still, he is 'somebody'. He is the leader who is supposed to have so many gifts and talents, good nature, good manners, wit and humour, and ability to inspire loyalty, a skill of a good administrator and often of a good craftsman. So actually people should look up to him as a man of distinction. But the higher ups don't think so. They say that he is management, but whenever they can they try to separate him from them. They don't consider him good enough to sit at their table. He discussed that question with a personnel manager, who told him: "I don't believe in this fancy idea that junior staff should sit together with senior staff. They can overhear our conversation and misunderstand." He feels that he and the other foremen are the least informed people in the whole works. Members of the works council discuss things, and they are the last to hear about them.

But does he himself inform the higher management about what is happening on the floor? Not much, if at all. A foreman is often a dumb creature, practically inarticulate. It is difficult to get anything out of him. In foremen's meetings addressed by the manager, it is hard to get any open and frank discussion started. They just listen, or at most nod their heads. They do not say much. What is the use? they think. The management will do whatever they want in any case. They turn to us only to preach at us.

When everything is right, not a word of recognition is ever given. But as soon as something goes wrong, you hear reprimands as if you were a schoolboy.

An elderly foreman said, "A good foreman must be impartial and must not be the management's mouthpiece only. He must be first of all respected by his men, and he must also respect them. You know if you want to be respected, you must give respect to others." A young foreman just promoted said, "My main trouble is with my former friends. Before I became foreman I got to know all their secrets, and somehow it does not seem right to make use of them now. It is difficult to keep your old friends, and somehow it is not easy to make new friends among the old foremen. They are a suspicious crowd, and I have found, anyway in this place, that they have many more fears than the workers have."

Another young foreman said, "I have no axe to grind, as I have no friends here. I live in a hostel because I came only recently. But all the same I find it extremely difficult to satisfy everybody, and it is extremely easy to lose your temper. In my view, you don't get anywhere by trying to satisfy everybody, or by shouting. You have to know inside yourself whether you are right and stick to it. Treat them fair and firm, and make them see that everyone has a square deal. When anything goes wrong tell them why. If they have done well, tell them: 'That was a good piece of work.' Some foremen will tell their men only when it is wrong. Give praise where it is due. It is the finest thing in the world when the manager comes along and gives encouragement and appreciation."

A foreman, a former shop-steward, described his experience in switching over from one position to another: "Going from a shop-steward's position to a foreman's was the greatest strain. I tried to extricate myself with dignity. I asked the Union whether they would agree to my promotion and whether they would accept my resignation, and they have been very nice about it. The main thing is to do it in a proper manner."

Now let us hear what an experienced manager has to say about his foremen: "The trouble is that most foremen are uneducated and quite ignorant. They don't know their job. We promote them or recruit them and train as best as we can, but it is always a risk. We simply don't know beforehand who will make a good foreman. And once a foreman is made, it is difficult to undo it. We need more study of what makes a good foreman, and how to discern such a man, how to pick him out and how to train. At present it is a haphazard affair. It is not good to promote him from inside and leave him in his department, but neither is it good to promote him from outside and to bring him as a stranger. It is no good bringing in a sociable chap, and it is still worse to bring in a strict man. It is no good bringing in a mere technician, and it is still worse to bring in a mere leader. A colourful personality with a sense of humour can get away with practically anything. But what is a colourful personality? The combination of qualities and virtues is unique and it is difficult to produce them in training. And unfortunately all virtues have their accompanying vices, and you have to take them too. And I can't see how we can possibly train a successful foreman if we don't train successful operatives. A good foreman needs good men to work with, in the same way that good men need a good foreman to work under. You can't have good foremen unless you have good workers, interested, willing and co-operative. A good foreman can help, I grant you here, but he can't do the whole job for you."

Another manager's comments were even more illuminating: "You say that you can't train good foremen unless you train good operatives. I will tell you another thing. You cannot have good foremen without good managers, and they need training first. Don't you see that a foreman is the first contact of the management, and when the management deteriorates he is first to suffer? He bears the whole burden of men-management relations on his shoulders, and when the atmosphere gets bad, his position may become strained to breaking point. When foremanship is bad in a place, look at the management and see what are their standards, and where the fault lies. Good foremanship is primarily a function of good management. 'Limited in his mind and unbounded in his aspirations.' That is what many a manager is now-a-days, and he often thinks that everybody needs training but not he, that every job must be trained for except the job of a manager, who is God-appointed and God-graced. Say what you like, but it is still true that the manager remains the life and soul of the Company. When a manager is poor, a good foreman cannot do the trick. One bad sheep will mar the whole flock, but what about one bad shepherd? Or do you think that a shepherd by the nature of his position can never be bad?"

Book Reviews

Training for Human Relations. By F. J. ROETHLISBERGER *and others.* Boston: Harvard University Graduate School of Business Administration (London: Bailey and Swinfen), 1954. Pp. xviii + 198. Price $2.00 (16*s*.).

The Harvard University Graduate School of Business Administration specialises in what it regards as "fundamental" or "pure" research. Unlike most other American Universities, which readily co-operate with industry in inquiries concerned with specific, immediate problems, it confines itself to matters that seem to its Research Division to be of general, long-term and basic importance. One such matter is "the kind of experience men need to develop new ideas and skills about human behaviour" (p.vi), and for some years the Harvard School has been engaged in a ten-year project designed to discover what this experience is and how it may best be provided for people who are being trained to become "human relations practitioners" in business or professional organizations. The book under review is an interim report on this prolonged experiment, and its ten chapters are arranged in three Parts, which deal with the "design", the "implementation" and the "evaluation" of the experiment up to the end of its third year.

The programme of training and research to which the report refers is difficult to summarize, but perhaps five brief statements will give some idea of its main features. (i) Its purpose is to train people in "human relations skill and research"—human relations skill being defined as "the capacity of a person to communicate his feelings and ideas to others, to receive such communications from others, and to respond to their feelings and ideas in such a fashion as to promote congenial participation in a common task" (p.172). (ii) The trainees are "human relations practitioners at the second level", *i.e.*, people who are being trained so that they themselves may train others, and carry out research, in human relations in business, educational or governmental organizations. In the first year of the programme there was only one trainee; in the second year there were five (including the man from the first year); and in the third year there were six (including two from the second year). (iii) The main activities of the trainees are: (*a*) observing and interviewing work groups in several different factories, and observing the human relations class in the Harvard Business School; (*b*) conducting small 'case-treatment' discussion groups, some composed of foremen, others of students; (*c*) taking part in their own discussion group; (*d*) advising students about university and personal matters; (*e*) engaging in individual conferences with members of the staff. (iv) In the view of the staff, the trainees learn "to see the complexity of relationships in concrete [human] phenomena and not to become too upset by it" (p.87); they also learn to see "some of the possible extensions and limits of the specialised skills, techniques, and approaches with which they come" (p.88). (v) The staff has arrived at certain conclusions: first, that, in the "multidimensional" world in which we find ourselves, skill in human relations is "a way of learning" not a technique—a way of learning "to deal skilfully with the conflicting and often unpleasant feelings that our encounters and involvements with the multidimensional world provoke" (p.141); secondly, that the "basic experiences" provided by the five activities outlined in (iii) are necessary in all training in human relations; and, thirdly, that, while a course that lasts nine months is much too long for human relations practitioners at the first level, it is much too short for those at the second level.

Clearly, the Harvard experiment, as it was at the end of its third year, invites considerable criticism. Some critics will object to its exaltation of skill at the expense of knowledge. Others will smile at its large conclusions based on subjective assessments of only nine trainees. Others, again, will think that Professor Roethlisberger and his colleagues were so impressed by the inter-relatedness of everything that they failed to make a definite study of anything. Still others will argue that, in industry (and elsewhere), training in human relations should not be divorced from the other essential elements in training for management (or from a clear picture of the prospective managers' duties,which is too often lacking); that human relations cannot be isolated from the actual work of the factory in its technical and commercial aspects; that consultation and an improved capacity to communicate one's ideas and feelings, though highly desirable, will not remove the opposition between labour and management; and that industry can easily have too much of the sort of discussion and analysis whereby individuals and groups are led to 'uncover', 'work through', or 'sweat out' their uncertainties, anxieties, conflicts and imperfections of behaviour. These last critics will have noticed that even the Glacier Metal research group is now focussing its attention, not on consultation, with the emphasis on discussion, but on "the precise definition of executive responsibilities, with the emphasis on decision", and that Mr W. B. D. Brown has recently said that the company's social-psychological research is now concerned with "work itself", not with "people in isolation from work", and that only such changes in human relations are worth studying as are likely to help the company "to do its job of developing, making, and selling bearings".

It must also be said that the style of the present report is not everyone's cup of tea. In their Preface, the authors uneasily warn off the reader who "will make a joke of what we say", and this apologetic *caveat* is accompanied by much defensive jocularity about the book's contents and purpose and why it should be read ("there are no 'good' reasons", we are told, "there are many 'bad' ones"). Also, throughout the book there is a marked avoidance of clear and concise exposition and a persistent preference for talking about things in a rambling 'free-associative' sort of way in the hope that one will thus be led "to see what one has not seen before".

Nevertheless, the book is worth attention. As the Harvard experiment is in the hands of able people, it embodies ingenious ideas, even if some of them seem somewhat familiar and faded and others serve only to remind us of Spinoza's remark about Descartes that he "accomplished nothing, save the display of his own great intellect". One of the more important of these ideas is the Harvard School's famous 'case-treatment' method, which aims at training people to deal with practical situations that demand prompt decisions on data that are inevitably incomplete. Moreover, the book's indirect, circuitous, allusive style, although it too is now becoming *vieux jeu,* still has some eminent practitioners in philosophy and psychodynamics on both sides of the Atlantic, and a tolerant reader, who is willing to control his impatience and to join the authors' ramble, is likely to feel at the end that he has been "enlightened about the commonplace", even if he also feels that he might have been enlightened more quickly, more systematically, and with less song and dance.

REX KNIGHT

Industrial Democracy: A Revaluation. By W. H. SCOTT. Liverpool University Press, 1955, Pp. 40. Price 3*s.* 6*d.*

This is an attractive, short essay, which will appeal to a wide variety of people inside and outside industry. Managers, trade union officials, social scientists, and everyone else who wants industrial work to be both an efficient means of production and a satisfying way of life, will benefit by reading Mr Scott's discussion of the case for more consultative leadership in industry, of the position of the trade unions, and of what he thinks the successful introduction of 'industrial democracy' would involve. The discussion of each point is extremely brief, but it is always limpid, and, instead of consisting of the usual windy assertions, it seeks to take account of recent fact-finding researches.

Mr Scott stresses the importance of "consultative leadership in everyday work relations" (p.15)—what is sometimes known as informal consultation on the job—as well as formal consultation at the policy-making level. Another of his main conclusions (which is less convincing) is that "separate negotiating and consultative procedures, with either distinct or common systems of representation, are undesirable" (p.29).

It is, of course, possible to disagree with some of his statements and to reject some of his arguments. Thus he now and then seems to imply that democratic behaviour necessarily involves continual consultation and is somehow inconsistent with the giving of orders; he sometimes seems to suggest that, with more consultation, we could get everybody in a factory interested in policies at all levels; he does not emphasise the profound differences between managers and workers in their loyalties and their attitudes to promotion, individual rivalry, group-sanctions, etc.; and he underestimates the vital importance to the morale of an industrial enterprise of confidence, not merely in the management's integrity, but also in its capacity to run the enterprise successfully.

These comments only show how stimulating Mr Scott's essay is; and, although some of his views are open to objection, it should be made plain that his general attitude is markedly realistic. After all, nothing could be more down-to-earth than his clear recognition of the fact, stressed long ago by John Stuart Mill, that, although there is an identity of interest among owners, managers and operatives in the prosperity of their firm, there is no such identity of interest in the division of the proceeds. Mr Scott is not one of those who think that the worker-boss conflict is merely the product of autocratic, uncommunicative management and will entirely disappear when the practice of consultation becomes firmly established. REX KNIGHT

The Use of Tests in Selection Procedure. By H. F. LOCK. London: British Institute of Management, 1956. Pp. 26. Price 5*s.*

It is good to read something by an author who knows what he is talking about. Into this 26-page booklet, prepared by the NIIP at the request of the British Institute of Management, Harold Lock and his colleagues have packed a remarkable amount of information and good sense. Short but crystal-clear paragraphs on validity, reliability, standardisation and item analysis prepare the way for brief descriptions of the main types of tests. These are models of modesty and caution. The best section of the booklet is on the place of testing in selection procedure. The whole thing is rounded off with a two-page account of group techniques and a reading list. The Appendix gives suggested programmes and timetables for four different kinds of selection procedure. The Appendix alone is worth five shillings to personnel and line managers who want a quick but reliable briefing. DENIS MCMAHON

The Object Relations Technique. By HERBERT PHILLIPSON. London: Tavistock Publications, 1955. Pp. x+224. Price, with 12 plates of test material, 63*s.*; test material only, 52*s.* 6*d.*; book only, 21*s.*

After working for several years with psychiatrists at the Tavistock Clinic, Mr Phillipson has published a projective test which he hopes will be useful to psychologists and psychiatrists in the assessment of human personality. He has used the test himself for five years. The test material consists of 12 cards, well drawn and reproduced. The book, however, is more than a handbook accompanying the test: there are 23 pages on the theoretical basis of the technique, 11 on the description of the test itself, 58 on a detailed case study, 56 on shorter case illustrations of the use of the technique, and the last chapter of 63 pages is entitled "Normative Data".

First, the theoretical basis: Phillipson (following Freud and others) believes that our attitudes to people and our relationships with them are largely determined by the relationships we have established in our early years and of which we may not be conscious. Furthermore, he believes (following Klein and Fairbairn) that the infant's confusion of himself with the not-self leaves a deposit of *internalised* object relations, some perceived as "good" and some perceived as "bad", and that frustrations and tensions arising out of the search for the "good" and the rejection of the "bad" objects may, if unresolved, profoundly influence our perception of situations and people. The relevance of recent work by Bruner and Postman is touched on. It is important to note that "object relations" refer not so much to early relationships with simple objects like tables and feeding bottles as to people and social situations. (This summary of the theory is grossly inadequate but not, I hope, too inaccurate. Phillipson recognises the difficulty of treating it satisfactorily in his 23 pages and refers the reader to the very full literature on it, which he cites and lists.)

A reviewer's interest in the theoretical basis can be limited to the question of how far the test material and the account of its use seem to tie up with the theory. In any event, this reviewer has neither the space nor the competence to embark on a thorough-going critique of the basic theory from which the test material derives. The test cards bear a superficial resemblance to Murray's Thematic Apperception Test series, portraying similarly ambiguous social situations which allow for many and varied interpretations by the patient; also they certainly appear capable of stimulating stories and fantasies which in turn can be interpreted in accordance with the object relations theory. They could presumably also evoke stories which could be interpreted in other ways. A more important answer to the question is provided by the case studies, which show how the story provided by a patient is analysed in accordance with the theory, although one feels that the material could have been interpreted in terms of quite different theories, with equal consistency and conviction.

It is for this reason that one turns with keen anticipation to the last chapter, headed "Normative Data", hoping that here evidence will emerge that the object relations technique is a valuable instrument of personality assessment in hands other than those of Phillipson and his colleagues. But this chapter is disappointing: it comprises abstracts of types of responses of 50 out-patients of the Tavistock Clinic and, separately, of 40 normal girls. As the samples cannot be equated, for age, socio-economic status and the like, comparisons are of little value, and, indeed, are not attempted. Phillipson mentions a group of delinquent girls who were given the test by O'Kelly: he makes comments on the differences in responses but no figures are given.

Phillipson is aware of the inadequacy of his present evidence and states clearly that he decided to publish the test so that more representative studies could be carried out and reported. It can be anticipated that there will be four reactions from psychologists: those who believe that any new lever to lift stones is valuable will buy the test at once and trust themselves to interpret what they see under the stones, basing their interpretations on either Object Relations theory, classical Freudianism or Jungism, or a hotchpotch of eclectic, ad hoc, experientially-derived pragmatism; another group will get the test immediately and proceed to do research with it, using control groups, tests of significance and so on; others will wait until the research findings are published; yet another group will "know" already that such instruments are scientifically useless, that neither test situation nor the interpretation can be objectified, standardised or quantified. But Phillipson and his colleagues will "know" that the last lot are past praying for, anyway.

DENIS MCMAHON

Interviewing for the Selection of Staff. By E. ANSTEY and E. O. MERCER. London: Allen and Unwin, 1956. Pp. xiv + 112. Price 10*s.* 6*d.*

This book was, in part, the outcome of discussion with a study group made up of men and women from industry, local government, hospital administration and the nationalised industries. The Royal Institute of Public Administration convened the group and sponsored, too, the publication of the book, one of an excellent series produced under their auspices in recent years. The authors have been able to use the experience, comments and suggestions of the group as well as their own considerable knowledge gained from the NIIP and Army and Civil Service selection work; the result is a notable contribution to the literature on interviewing.

The book is not primarily for the professional interviewer. It has been designed for "those who from time to time interview people to assess their suitability for appointment or promotion to a particular job". The study group urged the authors to write a book on interviewing which started from scratch and "assumed no previous expertise in the reader". How well does it achieve that aim?

The interview, as a stage in the process of getting a job, is put into perspective at the start. This is all to the good: "non-personnel" people need to be reminded of the aims, functions and place of the interview in the selection process and it is admirably and briefly done, before getting down to the real need—for a systematic approach to interviewing and to the preliminaries which precede it. Here, the book follows what has now come to be the accepted pattern: an outline of the 7 point plan for studying jobs and individuals; a description of the administrative work needed before an interviewing programme is worked out; the need for privacy when interviewing and the importance of studying written information before a candidate enters the room. All this is necessary for an inexperienced interviewer to know; the great merit of this book is that this task is carried out concisely but with no sacrifice of necessary detail. The authors are very fair and never dogmatic (except, and quite rightly, about good manners) and they succeed in covering, in 20 pages, a great deal of ground. Yet at no time does one feel hurried, nor has anything been omitted. This is quite a considerable achievement.

Chapter 5, which deals with technique, is one of the best in the book. A particularly useful section of it deals with the form of questions that can or should be asked; it is one of the few attempts I have seen to show any interviewer *what* to ask (horrible examples show him what to avoid, too).

Most books on interviewing say, "Let the candidate do most of the talking", but very few explain how you set about achieving that. An inexperienced interviewer is apt to take refuge in leading questions, or ones which merely call for a "yes" or "no" answer, simply because he cannot see how to ask the sort of questions which will "evoke long yet relevant answers". Anstey and Mercer do not advocate a set pattern of questions, as many Americans prescribe. Such an approach is much too inflexible. They give, instead, some general statement—such as "Not only should most questions require more than a stolid affirmative or negative, but they should vary in form" and then follow it up with a series of typical examples, which give real insight into the question technique of the really skilled interviewer.

The use of stress methods is rightly deprecated and could perhaps have been more firmly dealt with, as many senior managers who have to interview from time to time seem to think it important to impress candidates with their own importance, and thus seek to pulverise them to "test their nerve". Such people are a menace, and are usually the first to complain that they cannot get the "right sort of recruit". Throughout the book the need for courtesy to the applicant is rightly stressed. The two paragraphs on "Rounding off the Interview" and "Respecting Confidence" could well be framed on every interviewer's desk.

Two chapters deal with drawing conclusions from an interview. These, like the one on technique, are first class. The authors insist that judgments must be supported by observed facts, and make some pertinent comments on the sort of standards which are needed to set against a candidate's achievements. The importance of acquiring a wide range of background information is especially stressed and is re-emphasised in another (also excellent) chapter on the qualifications and training of the interviewer.

There are two useful additions to this book. The first is a discussion of the merits and demerits of Board and multiple interviews, which should be of use not only to the novice but also to the more experienced industrial psychologist or personnel manager who has to design a selection procedure in which his role is advisory, and other executives make the final decisions. This can be done in a systematic way, but yet be elastic enough to allow for individual differences in status and temperament. It should also help those whose role is advisory to get over one of the bugbears of that position where, despite being kept as the dog, other managers insist on doing all the barking.

The second addition is a little surprising—a chapter on how to be interviewed. Its advice is so shrewd that it will repay (as the authors intended it should) both applicants and interviewers to read it. The former will certainly profit from so doing, and the latter can hardly fail to find some useful indications of what may be his own failings, and of the sort of standard he can expect from a really good applicant. If this chapter were to be sold separately at the time of Industry's annual ivory hunt at the Universities, it should make the authors' fortunes.

This book has been criticised on the ground that, leaping ahead, it does not mention individual differences and how they are distributed. Apart from the fact that the reader for whom this book is designed might be expected to have some ideas of that subject already, such a criticism ignores the fact that the sort of executive for whom this book is designed does not interview large numbers of people as part of his job. He only sees occasional candidates for specific jobs. When that happens there is no particular need for a knowledge of the normal curve of distribution or of the ins and outs of rating scales, simply because he is dealing with very small numbers. Such knowledge as is given in this book seems entirely adequate for the purpose.

Some ten years ago, Dr N. A. B. Wilson outlined the major landmarks in the story of psychological interviewing—Burt's conceptual scheme, given in *The Young Delinquent,* Rodger's *The Seven-Point Plan,* Allport's *Personality,* Oldfield's *The Psychology of the Interview,* M. D. Vernon's article on social and dispositional drives and Jordan and Fear's well-known *Employee Evaluation Manual.* Few would deny that Dr Wilson has made his own contribution with his paper on "Interviewing candidates for technical training or appointments". To that list of pioneers we can now happily add Anstey and Mercer's book, which is a worthy follower in the same tradition and unquestionably the best book on interviewing that has been produced for many years. T. M. HIGHAM

The Measurement of Abilities. By PHILIP E. VERNON. London: University Press, 1956. 2nd edition. Pp. xii+276. Price 20*s.*

The first edition of this distinguished text book appeared in 1940 and had run to four new impressions by 1953. Professor Vernon has now taken the opportunity to bring it up to date at the time his publisher arranged to re-set the text in a clearer type-face and to print it on a higher quality paper.

The earlier edition will, of course, be well known to many readers of this journal, who will therefore be interested to compare the 1940 and 1956 editions to see the extent to which new work has necessitated radical revisions. The result suggests that a very solid foundation was laid in the earlier version, for the changes are largely the inclusion of results which were foreshadowed or tentatively indicated in the first edition.

In the chapters on statistical method the changes are all in the direction of additional notes on techniques which have become more generally employed in the last decade. The discussion of the treatment of small samples has been extended slightly, analysis of variance is discussed briefly, the chi-squared technique is given rather fuller treatment. (Unfortunately a proof reading error in the first edition has not yet been corrected: in the formula on the second line of page 89 the summation sign should cover the whole fraction, not just the numerator.) The $^{r}\phi$ formula to obtain a correlation coefficient from contingency tables is now included.

The list of mental and scholastic tests together with their suppliers, prices, time limits, age ranges, etc., has been thoroughly revised and extended, and provides a most helpful source of reference for the test user. In the chapter on the construction of new-type examinations there is a new note on practical examinations which possibly foreshadows considerable developments in this direction, and which seems to merit—although it does not get—a mention in the index at the end of the book.

In the chapters on mental tests and the factorial analysis of abilities there is a considerable amount of new material which gives a slight change of emphasis. The discussion of the innate bases of intelligence now draws on a wider range of evidence, and the effects of coaching and practice of tests is given quite detailed consideration. Not surprisingly the 11+ examination gets quite a bit of attention.

Are the changes sufficient to justify the possessor of a 1940 edition buying a copy of the new one? In your reviewer's opinion he would be wise to do so if he teaches psychology students or student teachers, or if he wants a convenient and up-to-date catalogue of commercially available tests. Others should see that their reference libraries have the new edition.

To the undergraduate psychology student who has not yet read either edition—what are you waiting for? JOHN D. HANDYSIDE

Year Book of Education, 1955. London: Evans, 1955. Pp. xii+644. Price £3 3*s.* 0*d.*

This book of 644 pages gives a comprehensive survey of guidance work in all fields of life, many parts of the world and from various angles of approach, *e.g.* from a general discussion of the ethical implications of all guidance to factual accounts of practical organizations in different countries, including some slight description of techniques and procedures. It is not intended as a manual for those wishing to qualify in any branch of guidance work; it is, rather, a general summary showing the historical background and development of the ever increasing work of guiding people in their various life problems, the present position and the changing outlook.

The term guidance is taken in its widest sense to cover all aspects of help given to one person by another who, by reason of greater maturity, expert knowledge or experience, is in a position to help in the solution of his life problems. It covers, for example, guidance in fields of religion, morals, education, aesthetic appreciation, choice of and adaptation to an occupation, personal, social and civic life, remedial guidance and rehabilitation; guidance for parenthood; and guidance on the problems of ageing. Contributions come from Belgium, Brazil, Denmark, France, Holland, India, South Africa, Sweden, United Kingdom, U.S.A. and the Islamic countries.

The book is divided into four main sections: I. Historical and Philosophical Background of Guidance; II. The Areas of Guidance; III. The Techniques and Organization of Guidance; and IV. World Frontiers of Guidance, consisting of one chapter on "Various Conceptions of Guidance" by Ruth M. Strang.

With the variety of authors of many races and nationalities and with the background of varied disciplines the articles naturally vary greatly in style and value, as well as in the outlook of the writers, whose conceptions of guidance differ somewhat, but probably all would agree with Professor M. J. Langeveld, who contributes an article on "Some Considerations of the Ethics of Guidance", when he points out that the aim of all guidance should be to foster the growing self-responsibility of the individual, the increased capacity to solve his own problems. There is apparent too, throughout, the general realization of what is clearly pointed out by Mr J. K. Frank, in an article on Remedial Guidance, namely, the growing conception of the need for a "wholistic" interpretation of guidance in lieu of the specific guidance in the various aspects of life, the essential inter-relation of physical, mental, emotional and sociological conditions underlying all problems and guidance programmes.

While guidance is considered largely as a matter of individual adjustment, Mr R. C. Wright, in his article on the "Organization of Guidance Programmes in Great Britain", includes such general educational activities as those of the BBC and the Arts Council, as well as the more personal services of school and youth clubs; while Helen H. Randall points out the need of greater group guidance facilities, owing to the impossibility of making adequate provision for individual services.

In the field of industrial psychology and vocational guidance articles are contributed by Mr H. F. Lock (formerly Assistant Director of the NIIP) giving an account of the vocational guidance services of the Institute; by Mr H. R. King (Headmaster of Wandsworth School) on "Vocational Guidance for School Pupils"; by Professor Hamden L. Forkner (Professor of Education and Head of Department of Business and Vocational Education at Teachers College, Columbia University) on "Guidance within Industry"; by Professor F. J. Th. Rutten (Professor of Psychology and Director of the Psychological Institute at the University of Nijmegen) on "Guidance within Industry in Holland"; by Dr N. A. B. Wilson (Senior Psychologist to the Admiralty) on "The Development of a Naval Officer: Great Britain", and by Dr Abraham S. Levene (Head of Selection and Criteria Research Section, Bureau of Naval Research) and J. J. Cowan (Head of Officers Personnel Research Unit) on "Officer Guidance in the United States Navy"; and by Professor Albert S. Thompson (Department of Guidance, Teachers College, Columbia University) on "Industrial Relations".

Other fields of guidance, outside the vocational and industrial, are treated with similar detail and comprehensiveness. The book therefore forms an encyclopaedic volume of general information on the subject.

M. B. STOTT

Dynamic and Abnormal Psychology. By W. S. TAYLOR. N.Y. American Book Co., 1954. Pp. xiv+658. Price 41*s*. 6*d*.

Professor Taylor's explicit purpose in this textbook is to concentrate on the less abnormal of the abnormalities; on the dysfunctioning of everyday processes. He has therefore organised his material largely within the framework of the concepts of general psychology. A first glance at the chapter headings gives the impression that this is a general textbook, but the chapter on 'Learning and Memory', for example, does not give a systematic treatment of what is known about the normal functioning of these processes; that is not his purpose. Instead, he sets out to describe the minor pathologies of learning and memory. Such chapters comprise a large proportion of the book and only a final chapter is devoted to the more severe psychoneuroses and psychoses.

This, then, is a textbook with something of a new look. It is likely to be of use mainly to the layman and to the not-too-advanced student. For these readers, it has the advantage of being packed with illustrative material, largely of an anecdotal nature.

Apart from this overall design, it is a book without a systematic viewpoint. To express the point differently, Professor Taylor has no axe to grind. Perhaps it is as a consequence of this, however, that the book is difficult to read through from cover to cover. Sub-headings lie thick upon the page, partly because of excessive preoccupation with concepts and definitions. One section stands out for the pleasure and ease with which it can be read, and that, a concise and comprehensive account of the history of the psychoanalytical movement, was written by Austin B. Wood. The preoccupation with definitions runs throughout the text and into a glossary at the end, a glossary which gives etymological translations as well as definitions. Here there is often a redundancy of information; for example, "Psychogenic (mind-produced). Produced by mental processes", but it is probably worth it to have "Psychoanalysis (mind-up-loose condition)".

In many ways the book gives the impression of having been written straight from a carefully organised card-index. It is suggested, for example, by the unusual practice of giving as a reference very often only the relevant item number and volume of *Psychological Abstracts*. And quite often one feels that the process of building the card-index ended too early. Thus there are many more references from the 1800s than post 1950. Recent references are given on only a few selected topics; one of these is sexual motivation, yet Kinsey is nowhere mentioned. The date of Hull's death is left blank although he died two years before the book's date of publication. And finally there are some notable omissions: for example, psychosomatic disorders receive only two brief references and there is no mention at all of controlled experimental work into subjects such as perceptual defence, rigidity of thought and intolerance of ambiguity.

THELMA VENESS

Wildcat Strike. By ALVIN W. GOULDNER. London: Kegan Paul, 1955. Pp. 180. Price 16*s*.

This book is not complete in an important respect. The research method of Dr Gouldner and his team cannot be judged without reference to a companion work *Patterns of Industrial Bureaucracy*. From this the method appears rather loose, depending on copious interviews, formal and informal, of which the plan, structure and direction are not clearly described. Conclusions about 'the workers' are often illustrated by a quotation from an interview; and many readers will have uneasy thoughts about how representative the illustration may be, and how well-based the reasoning from it. It may be, as Dr Gouldner says, that "No one who studies a group will go far wrong if he gets close to it"; but with such an opportunity it seems a pity that the enquiry was not more purposeful and the findings more clearcut. Comparison springs to mind with a book published in the same year by a research team from Liverpool University which also had the opportunity to consider an 'unofficial' strike which occurred during the period of the research. There, the method was thought out and stated very carefully and the conclusions inspire more confidence. In this, *Wildcat Strike* compares unfavourably with *The Dock Worker*. However, the time and resources which went into Dr Gouldner's research enabled the prime requirement of gaining access and acceptance to be achieved excellently, and the frequent quotations suggest a yield of free expression which is undeniably rich. Detailed studies of particular strikes are rare, and for this reason the book must be counted as a useful addition to the literature about strikes, against which other ideas and findings may be checked.

The focal assumption of this analysis of a 'wildcat' strike is stated on p. 17: "The stability of worker-management relations ordinarily rested on a set of shared expectations which the men in one group had concerning their rights and privileges, and the degree to which those in the other group conformed to these." From this is developed a concept of 'the indulgency pattern' which takes in all these informal expectations. It should be pointed out that this is not the only way of analysing the facts as the author gives them. For example, a focus could be found as well in interference with habits as in frustrated expectations. Both these are operational analyses and attack the problem at a given time and level from which one looks forward and the other back. Either could be a useful way to open up the problems. Neither asks for underlying, more permanent, explanations, *e.g.* why workmen formed such habits and expectations, whether the nature of the work was such that unrest was continually forming and whether the social cohesion of the workpeople would favour or inhibit mass expression of unrest. These are deeper questions than Dr Gouldner asks; and it is probable that they must be asked before we can come to an adequate understanding of strikes, particularly 'wildcat' strikes. It may not be so much a matter of interruption to an equilibrium as constant pressure on a precarious equilibrium if one exists at all. Monotonous and fragmentary work, social isolation on the job, speed of work that is unnatural, chronic insecurity in the community at large—these and other things may be breeding unrest widely, which given some focus or leader or critical intensity issues in a strike and otherwise finds expression in individual behaviour.

From the description of a 'unique industrial conflict' Dr Gouldner proceeds to the 'rudiments of a general theory of group tensions'. His preamble leaves us no further advanced on the important problem of the relation of group and individual tensions beyond adding another assurance that the two closely interact. Also (pp.129*ff.*) he seems to use the term 'status' where most writers would use 'role'. His approach to his task is again operation through analysis of 'symptoms', 'zones of disturbance' and 'conditions' which frustrate expectations. "The generic question is always: Under what conditions is it possible for the aggrieved party's expectations to have been frustrated?" In itself, this approach seems too superficial to yield much in the way of general theory, and his seventeen general propositions reflect this. Only when we pass from expectations for a while and reach propositions that cover 'the desire for approval', persisting 'distrust', 'defence mechanisms' and 'power differentials' does there seem much depth of explanation. There is little consideration of determinants of tension in groups which may be unexpressed or unsuspected by group members. Apart from these general criticisms, some of the propositions could be questioned in particular. For example, propositions 2 and 5 maintain that tensions increase where expectations are not clear or are not perceived. Surely there would be many instances in which vagueness or unawareness of expectations had proved a safety valve to ease tensions?

Dr Gouldner's literary style is not pleasing: mixed metaphors, frequent italics and forced emphasis, useless suffixes such as 'ized' and 'istic', participles which need not be present, all weaken the exposition. More serious is a craving to precis concepts and give them titles, with the tendency to choose these ineptly: 'In short', 'In a word' and 'In brief' come in frequently; 'the indulgency pattern', 'organizational character' and 'the career of the defence' are not happily chosen; and whether 'the Rebecca Myth' deserves the universality of Oedipus or not, the title will probably mystify everyone except half a generation of film-goers. Misprints, spelling errors and lack of an index also detract.

E. P. KELSALL

Management Succession. By THE ACTON SOCIETY TRUST. London: The Acton Society Trust, 39, Welbeck Street, W.1, 1956. Pp. viii+140. Price 10*s*. 6*d*.

When one considers how vital British industrial effort is to our national and individual well-being, one cannot but marvel that those outside industry know so little about it. The industrial novel, for example, is of very recent growth. The authors and novelists who might paint the picture or convey the atmosphere have little background knowledge to draw from. Their heroes are doctors, lawyers, professors, clergymen or teachers;

and the few industrialists who do appear seem to spend their time running dark Satanic mills in which they grind the faces of the poor.

One consequence of this seems to be that teachers have a certain natural reluctance to encourage their best boys to go into industry. They have been taught to value highly a liberal education, a university degree, and professional status, and they know best the path which they themselves have followed. So their brightest young hopes are encouraged to study classics or theology or law. This was a matter of little significance to industry as long as there was a fair amount of inequity in the provision of further educaton, as long as exceptionally gifted boys were still to be found in any numbers in secondary modern schools. But the eleven plus examinations, although much maligned, do a fair job nowadays of diverting the more intelligent into years of further liberal education, and the circumstances are all in favour of an able pupil proceeding to university, probably to an Arts degree. This has and will have serious consequences for industry. At present they are felt in a lowered quality of the ordinary intake into industry, and a shortage of intelligent young craftsmen, which will in time have more serious effects on the quality of industrial management. Many companies are already short of suitable replacements particularly at the top levels. Beyond the level of works manager it is already difficult to find people within a company with the breadth of experience required for the post of general manager. If the present trend continues it will become difficult to fill adequately from within companies, posts well below the level of works manager. Companies then have the choice of tempting their management from the schools at an early age possibly by promising them a 'liberal industrial education', or recruiting managers from outside, or acquiescing in a lower level of intelligence amongst managers; and with many, the last alternative will probably come about by default.

One can judge how ill prepared are most companies to meet this disturbing situation by studying the conclusions of this book, and reading between the lines. The importance of early selection and training of managerial talent from within and from outside companies is not generally realised. In many companies the only realisation will be made in the ultimate emergency, when it is discovered at the death, illness or resignation of a capable manager, that there is no one available to succeed him. People on the shop floor regard 'knowledge of the job' as the one sound qualification for promotion, and yet those who know most about the job are diverted to specialist departments such as drawing or design offices, where their potentialities as managers are ignored. Promotion may be fair, but if a company's promotion policies and the factors affecting promotion are secret, and employees get neither knowledge of progress nor encouragement, the system may well appear unjust. Employees may of course have reason to be cynical. Top managers tend to think that they know everybody, and may confuse the ability to recognise a person with a knowledge of his potential, and the more important the job, frequently the less objective the selection. Some companies do attempt to meet the situation by employing graduates : but their problems only begin there. Frequently graduate training in a company is not fundamental and experience is largely irrelevant to the eventual work of management. Even with the best training plans the control over content of training may be absent, and staff reporting procedures may be quite unreliable. Graduates may be subject to much frustration until they are given real responsibility, with the consequence of considerable wastage in the graduate intake.

This gloomy picture, however, describes the problems which this book sets out to help management to solve and not the book, which is eminently readable, objective in its approach and constructive in its criticisms. The first part is a survey of the educational background and career history of 3,327 managers in 27 organisations employing over 10,000 people. The main conclusion is that those from public schools and those with Arts degrees or professional or non-technical qualifications are occupying more and more positions in management, especially top management, while fewer positions are occupied by those who started as clerks or manual workers. The sample is admittedly biassed towards firms with more progressive policies, but the trend may indicate that companies in their own interests will be forced to recruit more managers from outside.

On the other hand it may indicate what sort of education top management are inclined to afford for their sons. The problem of nepotism seemed to be too much of a wild goose for the authors to give chase.

The second part of the book is a survey of how 51 companies recruit, select, train and promote their future managers, what problems they have found, and how they have tried to solve them. Again those companies which were willing to provide information tended to be the more progressive, who had gone further towards dealing with these problems; but this tendency enhances rather than detracts from the value of the book as a guide to improved practice.

The third part is a study of the reactions of employees to the management succession policies in five large firms. In each of these firms around 80 employees were interviewed on their attitudes to promotion for themselves and to the promotion of others. The findings from this section provide a useful guide to companies who wish to ensure that objective procedures of selection are seen to be fair.

To sum up, managers who are concerned by these problems will find in this book little criticism of what has been left undone, and much constructive guidance as to what might be done in the future. We would also recommend it strongly to any indispensable person who has thought about where a successor of his own calibre will come from—and has been worried by the thought. DAVID C. DUNCAN

Clinical versus Statistical Prediction: A Theoretical Analysis and a Review of the Evidence. By PAUL E. MEEHL, Minneapolis: University of Minnesota Press. Pp. x + 149. Price 24*s*.

Professor Meehl is concerned with the argument between 'clinicians' on the one hand, and 'statisticians' on the other, over the relative merits of their respective methods of assessing psychological data and making prognosis. He considers (and illustrates his case) that the bulk of the argument is polemic, and endeavours to cool the argument by plain reason. To a considerable extent he succeeds, though at times there is some confusion in his presentation. His attempted distinction between what he calls the discriminative and the structural use of statistics is an interesting but brief blind alley to the main thesis, which is that any prediction, no matter how arrived at, is capable of statistical validation.

There is a comprehensive survey of previously published arguments and evidence.

Some of the most interesting discussion is concerned with the nature of clinical intuition. The general position is put forward: "The clinician may be led to a guess which turns out to be correct because his brain is capable of that special 'noticing the unusual' and 'isolating the pattern' which is at present not characteristic of the traditional statistical techniques. Once he has been so led to a formulable sort of guess, we can check up on him actuarially." Although there are a number of cases cited to demonstrate 'clinical intuition', and although the author is at pains to discount the minimal cue theory of clinical judgment, there is no statement nor guess as to the mechanism of this special judgment. Neither is there any discussion of practice or methods of learning to guess. Clinical intuition is left as a mystique.

A cynical note on the progressive shrinkage of the test battery used and the time spent by the psychiatrist as he moves from official practice to private practice does suggest, however, that the important problem to be faced is economic. It is not just statistical versus clinical, it is how can we best make predictions in limited time.

J. W. WHITFIELD

The Civil Service. By FRANK DUNNILL. London: George Allen and Unwin, 1956. Pp. 226. Price 18*s*.

This book should be read before entering rather than after leaving the Civil Service, but while it should be compulsory reading for Government psychologists, it contains much that is of interest and value to psychologists concerned with other large organisations. The author, a Principal in the Colonial Office and still in his mid-thirties, has travelled the 'hard route' from clerical officer, supplementing his experience with a period of observation in the United Nations Secretariat. His war service in the Royal

Navy no doubt gave him opportunity to understand something both of 'the public' and of the effects on it of Civil Service methods. He would appear to be well-equipped, through these experiences and the possession of an alert mind unaffected by the 'lower-deck outlook', to survey the strengths and weaknesses of departmental organisation and management. It is not surprising that he has produced a penetrating account of the interdependencies of, and interactions between, Civil Servants of various levels, and of their relations with their organised and unorganised publics.

The reader who is unfamiliar with the structure of the Civil Service may do well, as Mr Dunnill himself suggests, to approach the book through its eight appendices, which give a brief but clearly set out picture of departmental organisation, of the distribution of civil servants, and of the composition, duties and conditions of service of the four major classes. While some mastery of these details is necessary for an appreciation of the body of the book, the latter is in no sense built around charts and statistics. It is, rather, an account of the dynamics of central government as determined and affected by the characteristics of its personnel. Mr Dunnill demonstrates unmistakably that the strength of the service is closely related to the quality and training of its middle-management ("the meeting place of two essentially different types: the administrative amateur —quick, light, theoretical—and the executive—heavily professional"). It is shown that the service is beset in an acute form with problems of management succession, foremost among these being uneven age distributions largely attributable to sudden wartime expansions of staff. Our attention is drawn to the somewhat artificial distinctions of function between grades, leading to communication barriers only partly overcome by large scale internal promotions. (Of the 2,597 officers in the administrative class at 1 July, 1953, no fewer than 1,248 had entered through another class.) In the author's opinion the remedy for these difficulties must be sought largely within departments, since in the long run the effectiveness of remedial measures will depend almost entirely on the promotion of effective attitudes and ways of approach to organisation and improvisation. In this he is undoubtedly right, for top-management support is a prerequisite, and internally devised improvements tend to be the most acceptable; but he might have said more about the possible value of 'outside' diagnosis and stimulation, whether these come from the Treasury's organisation and methods team or from independent consultants.

In the concluding chapter there are some interesting suggestions for fostering a spirit of enquiry both into the reasons why, and into the necessity for, things being done as they are, or at all.

DERMOT STRAKER

Other Books Received

A Group Guidance Project. By BUREAU OF PSYCHOLOGY. Uttar Pradesh, Allahabad: Bureau of Psychology, 1956. Pp. iv+52. Price not stated.

Information pa Arbetsplatsen: Sociologiska Studier av Företagets Kommunikationsproblem. (Internal Communication.) With an English Summary. By EDMUND DAHLSTROM. Stockholm: Studieförbundet Näringsliv och Samhälle, 1956. Pp. 324. Price Sw. Kr. 14:50.

Automation in Theory and Practice. Edited by E. M. HUGH-JONES. Oxford: Blackwell, 1956. Pp. x+140. Price 12*s.* 6*d.*

Supervision of Scientific and Engineering Personnel. Compiled by JOHN T. LLOYD *and* ROBERT D. GRAY. Pasadena: California Institute of Technology, 1956. Pp. vi+82 Price $8.75, (reduction 2 or more copies).

Scientific and Engineering Manpower in Great Britain. By MINISTRY OF LABOUR AND NATIONAL SERVICE. London: H.M.S.O., 1956. Pp. 28. Price 1*s.* 6*d.*

The Psychology of Occupations. By ANNE ROE. New York: Wiley, (London: Chapman & Hall), 1956. Pp. xii+340. Price 54*s.*

Nonparametric Statistics for the Behavioral Sciences. By SIDNEY SIEGEL. London: McGraw-Hill, 1956. Pp. xviii+312. Price 49*s.*

Eleven-plus and all that: the Grammar School in a Changing Society. By FLANN CAMPBELL. London: Watts, 1956. Pp. xviii+194. Price 15*s.*

The Design and Conduct of Human Engineering Studies. By ALPHONSE CHAPANIS. San Diego, California: State College Foundation, 1956. Pp. iv+74. Price $2.

Communication: Handling Ideas Effectively. By ROY IVAN JOHNSON, MARIE SCHALEKAMP *and* LLOYD A. GARRISON. London: McGraw-Hill, 1956. Pp. x+362. Price 34*s.*

Conference Leader's Guide for Supervision of Scientific and Engineering Personnel. By JOHN T. LLOYD *and* ROBERT D. GRAY. Pasadena: California Institute of Technology, 1956. Pp. iv+76. Price (with previous volume) $8.75.

Selecting Supervisors. By MILTON M. MANDELL *and* SALLY H. GREENBERG. Washington: U.S. Civil Service Commission, 1956. Pp. vi+54. Price 25 cents.

The Grievance Process: Proceedings of a Conference. By MICHIGAN STATE UNIVERSITY: LABOR AND INDUSTRIAL RELATIONS CENTER. Michigan State University, 1956. Pp. 102. Price not stated.

The Social Problem of Mental Deficiency. By N. O'CONNOR *and* J. TIZARD. London: Pergamon Press, 1956. Pp. viii+182. Price 30*s.*

Rehabilitation, Autumn, 1956. Quarterly Journal of THE BRITISH COUNCIL FOR REHABILITATION. London: B.C.R. Price 2*s.* 6*d.*

Hearing Defects of School Children. By SCOTTISH COUNCIL FOR RESEARCH IN EDUCATION. London: University Press, 1956. Pp. x+114. Price 10*s.* 6*d.*

A Guide to College Recruitment. By SOCIETY FOR PERSONNEL ADMINISTRATION. Washington, D.C.: S.P.A., 1956. Pp. iv+16. Price 50 cents.

Professional Standards for Personnel Work. By SOCIETY FOR PERSONNEL ADMINISTRATION. Washington, D.C.: S.P.A., 1956. Pp. iv+32. Price 50 cents.

Human Disease. By A. E. CLARK-KENNEDY. London: Penguin Books, 1957. Pp. 268. Price 3*s.* 6*d.*

Civil Service or Bureaucracy? By E. N. GLADDEN. London: Staples Press, 1956. Pp. 224. Price 21*s.*

Technical Change and Industrial Relations: a Study of the Relations between Technical Change and the Social Structure of a Large Steelworks. By W. H. SCOTT *and others.* Liverpool: University Press, 1956. Pp. x+336. Price 17*s.* 6*d.*

Employment Interviewing. By MILTON M. MANDELL. UNITED STATES CIVIL SERVICE COMMISSION. Washington: Government Printing Office, 1956. Pp. iv+104. Price 40 cents.

British Social Work in the Nineteenth Century. By A. F. YOUNG *and* E. T. ASHTON. London: Routledge and Kegan Paul, 1956. Pp. viii+264+16. Price 25*s.*

Work and Authority in Industry: Ideologies of Management in the Course of Industrialization. By REINHARD BENDIX. New York: Wiley (London: Chapman & Hall), 1956. Pp. xxvi+466. Price 60*s.*

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Improving Employment Reference Checks: Guides for the Construction and Use of Mail Reference Questionnaires (Vouchers) to Obtain Employment Information on Job Applicants. By THE UNITED STATES CIVIL SERVICE COMMISSION. Washington: Government Printing Office, 1956. Pp. vi+86. Price 45 cents.

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Knowledge of Results and 'Skilled Performance'

By JOHN ANNETT and HARRY KAY

The authors are members of a research team working at the Institute of Experimental Psychology, University of Oxford.

INTRODUCTION

"KNOWLEDGE of results is the *sine qua non* of any kind of learning but we cannot say what results are taken note of by the operator learning to track because we do not know of what he supposes them to be the result." (Hick and Bates, 1950). We might say that the present paper accepts the first half of this above statement and attempts to discuss some of the issues raised by the second. Recently (Annett and Kay, 1956) we have outlined an approach to motor skills which emphasises the significance to the total action of the stream of signals arising both from the external display and from the operator's own responses. Now it is proposed to examine ways in which this approach may be of use in a reassessment of some of the many problems of knowledge of results. After a brief survey of what we will call the perceptual approach to skills we shall attempt to outline some of the different kinds of knowledge of results and discuss some of the problems raised by them.

THE PERCEPTUAL APPROACH TO SKILLS

Let us first consider how our present approach to the study of skilled behaviour is connected with the subject of knowledge of results. In skilled performance we have a series of signals arising from two sources; one from the external environment, probably a display in front of the operator, and one from the internal environment, the operator's own musculature and nervous system.

It follows that one of the primary features of skilled performance is the perceptual ability of the operator in receiving incoming signals and an important problem is how we assess this ability. One way is to measure the difficulty of a task by calculating the amount of information carried by its events in terms of their uncertainty. Let us first consider events which are independent of each other. If event x occurs out of a possibility of x and y it carries less information than if the possibility had been x, y and z. Where an event is extremely uncertain or improbable it carries much information, that is its occurrence resolves much uncertainty, and hence a task in which anything might happen is one in which much, perhaps too much information has to be received. In the case of a car driver, whether another vehicle or a pedestrian will be at the cross-roads is an event independent of his own actions. Each is likely and neither carries much information. The motorist is not surprised to find another car at the cross-roads but he is to find an elephant. Some tasks, of which vehicle control—buses, lorries, trains, aeroplanes, etc.—is an outstanding example, may present the most skilled operator with an uneven flow of information, particularly where there is an unexpected situation in which there is nearly too much information to handle. For this reason they are difficult and 'responsible' skills. The operator in the everyday execution of his task may be receiving little information but he must maintain a state of alertness so that he is ready to receive very much more information if necessary. Many industrial tasks try to avoid this state by automatically stopping the machinery if anything untoward occurs. Any skill where this cannot be done and where the operator will have to cope with these high peaks of information will always be responsible tasks.

In those cases where events are not independent the trainee's task is to learn the sequential dependencies and on the face of it this seems easy enough. If *a* is followed by *b* then the operator should soon recognise this dependency, but as already noted an operator is receiving messages from two sources, internal and external, and no matter how constant one source may be, say from the display, it may appear very irregular if intermingled with a sequence of random signals arising from the operator's own irregular responses. Several recent experiments have illustrated how confusing this may be, as it was in a study by Von Wright (1955) in which subjects under paced conditions had to learn twelve consecutive responses, each being a movement to either left or right. When subjects attempted to make these responses with a stylus and then observed whether they were correct or not, it took five times as long to learn as when they simply learned the sequence from the display without putting in their own overt and often wrong responses; that is, they learned the constant series of signals from the display so much more quickly when they were not intermingled with other signals from their own responses.

We can say that in those tasks where one event is dependent on a preceding event the trainee is gradually learning to appreciate the redundancy of certain signals. Thus the operator will be able to receive more and more events in any Unit time, though receiving the same amount of information, since he has learned to appreciate how certain he can be of so many signals before they occur. As a result in an unpaced task, such as reading English prose, we get an increase in the speed of performance. We have, then, two conditions for this kind of improvement. Firstly that an operator is able to appreciate relative degrees of uncertainty in forthcoming events and secondly that he is able or prepared under some circumstances to 'react' to signals which are less than certain; here he is making predictions and in fact acting on them.

During any training process there may be then a systematic change in the value of particular signals for the operator. Different methods of training may emphasise different signals and of course there is no guarantee that every method will utilise the minimum necessary signals. Touch typing would seem to be an example of one method where this is successfully achieved. Those who use vision for locating the keys are using more cues than necessary so that we have an uneconomical number of signals. It is of note that for most everyday skills which are overlearned an individual receives signals which tend to be redundant. Constant visual control is often unnecessary, as in writing, but the redundancy allows a wide and at times useful margin for the unexpected event and for occasional monitoring, as in the writing example, when crossing *t*'s and dotting *i*'s.

In more technical skills where the emphasis is upon speed of performance the question of economy through following the best method is all important. To carry out any task an operator will require a certain number of signals but it is important that he should only use the minimum necessary. We might say that any task has for the operator an optimal information content which will be that amount of information which is strictly necessary for carrying out the task, plus that amount of redundant information as will provide the most economical safety margin. An interesting operational example of this point occurred in an investigation by Fritz and Grier (1954) who measured the information transmitted between aircraft pilots and control tower during landing operations. The investigators were surprised by the large amount of redundancy and were forced to the conclusion that some redundancy was necessary in a situation where the loss of even a small amount of information might be disastrous.

Of course, this measure of the amount of information in terms of the number of alternatives is limited, it has nothing to say about the importance of signals, but it does provide us with an elegant means of assessing events which is particularly valuable where we are emphasising the perceptual aspect of skills and formulating skill problems in terms of the transmission of information rather than in terms of stimulation. Here we can take the analysis a further stage. The operator is not only considered to be receiving signals (information) but he is also, by virtue of his responses transmitting signals. On the one side we have so much input and on the other so much output and the correspondence between the input and the output messages gives a measure of the capacity of the communication channel, in this instance the skilled performer. Where the operator is given more signals to receive than he can handle he necessarily loses some and the errors in his responses reflect the loss of information. We can infer from this loss that the channel capacity is below this level.

Any training programme aims to teach the operator to handle incoming signals and does so largely by teaching him to recognise the redundancy of others. The problem to be solved by research on knowledge of results is how signals may be optimally presented in order to arrive at this optimal information value for a task in the shortest possible time. If we consider the removal of knowledge of results as a kind of transfer from the training to the operational situation the importance of the way in which extra feedback cues are given will be readily appreciated. Cues, whether 'natural' or 'extra', which carry information essential to the task cannot be removed without a loss of efficiency. However, if the training process is so arranged that extra cues, whilst helping the operator in the first instance, later become redundant, these cues may then be removed without any serious loss of efficiency. It is therefore necessary to think in terms of the probable optimum cues which will be finally used in the task and then to arrange extra feedback in such a way that the operator will eventually be getting the necessary information from such cues. The following sections develop a few ideas as to how this may be best brought about.

DIFFERENT KINDS OF KNOWLEDGE OF RESULTS

It is within this context of considering the perceptual discriminations involved in motor skills and the concept of motor performance involving a transmission of information that we wish to examine knowledge of results. The whole task is often a cycle of events in which the operator will not only be receiving a great number of signals, but if the responses are lasting any length of time many of those signals will be the result of his own actions. Hence the receiving of signals from internal and external sources is intrinsic in most skilled performances. Knowledge of results is not then something which a scientist has ingeniously introduced into a training situation—it is something which will be inherent in that situation from the moment when the trainee is given any rudimentary idea as to what he is to try to do. Whether an experimenter does or does not give knowledge of results the adult trainee in nearly all situations will be receiving considerable information about his performance.

This approach then emphasises two elementary but important points. Firstly there is always some knowledge of results and secondly there are many different kinds. We have commented enough upon the first but the second takes us to the root of the problem. What the trainer aims to achieve by knowledge of results is to add something to those signals which the trainee will normally receive. Knowledge of results will be augmented feedback for the operator. We may now go on to ask in what way this is so, what are the governing conditions which determine when and how knowledge of results should be given, and how this determines the different effects of knowledge of results.

KNOWLEDGE OF RESULTS AS A DIRECTIONAL INDICATOR

The commonest example of knowledge of results is the end score. Let us say the aim of a task is to perform an operation in a certain time or within a certain degree of accuracy. Here the end score gives the result. As a directional indicator such an end score does not particularise individual responses. Where the task is complicated as in an operation involving a number of responses in quick succession, it is likely that such a score provides little indication to the trainee where and how to amend his performance, though he may be able to guess at the point from a general knowledge of his performance. The same holds for end scores which are given in terms of a mismatch signal of how far a response or responses failed to achieve a criterion. But what both kinds of signals do give the trainee is a much more exact indication of what he has achieved than he is likely to have gained from information received from other sources. Why is this? In the main because such scores will be presented in terms of fairly well known scales, for it is a feature of such scales that it is generally a simple procedure to translate the terms of one into those of another. For example, an athlete when given his running time for a particular distance can easily determine how far he is above or below his required speed, and this is likely to be more accurate than his subjective impression of how fast he was running. It is one of the trainee's main problems to translate the signals he is receiving into some measurable scale though the skilled man may be able to do this, indeed his ability to do so is often taken as the mark of the expert. In tasks such as that of a wool sorter classifying different bales of wool or a mechanic tracing a fault, it is difficult to identify the precise cues which are being used. But this takes us into the second kind of knowledge of results, as a performance index within the task itself rather than an end score from which the operator has to infer characteristics of his last performance.

KNOWLEDGE OF RESULTS AS AUGMENTED FEEDBACK

As we have noted, in carrying out a skilled task an operator is making a series of responses which in turn give rise to a series of incoming signals. These may be in addition to any signals which the operator is receiving from his external environment and which may be occurring regardless of his own responses. From this series of signals the operator has to learn which are relevant, which can be ignored, which are a guide to events in the future and so on. And to the trainee nearly all these signals will initially be without 'labels', that is they are on no known scale nor tied to known consequences. His task is to learn to identify the signals and to learn their significance. The usual way to meet this kind of difficulty is to provide the operator with some scale indicator which deals with a particular signal and has a clearly defined area signifying one kind of event: for example the car driver finds a thermometer on his dash-board with a marked region near the boiling point mark which tells him if the engine is getting too hot, and similarly with revolution counters and oil pressure gauges. What was vaguely engine noise can then be read off as so many revolutions per minute. But where we have a multiplicity of signals being continuously received as in skilled performance the trainee is faced with several problems. To aid him we have to decide

(i) which signals are most relevant to the execution of the task;
(ii) which signals are hardest to identify; and
(iii) how far it is possible to provide any further indications for those signals.

(i) In many operations it is by no means an easy problem to decide which are the most relevant signals. The expert exponents have not always agreed on the essentials and theoretical analysis can help here in indicating where the key points are in the operation. For example, as already noted, it would appear that as a trainee learns a skill the functions of some signals change and this is most marked in serial skills where responses and signals are closely linked together. In such tasks many signals become redundant in so far as they could have been predicted from previous signals, and the trainee has to appreciate their unimportance compared with the non-predictable signals carrying most information. Unfortunately signals which become redundant when the skill is properly executed may not be so in the relatively random sequences of a trainee's responses. Hence it is not always possible to get the beginner to train on the same cues as the expert. The final aim is for the operator to receive the maximum of information from the minimum of signals, but the training programme has to recognise that the information value of certain signals may be changing as the skill develops, thereby entailing the use of additional signals in the initial stages of training.

(ii) A signal may be difficult to identify for several reasons. It may occur only briefly, it may be one in a succession of signals, it may involve a comparatively poorly developed discrimination such as a pressure cue as opposed to a spatial movement, or it may be a signal which is only just above the differential or absolute threshold. The trainer having decided upon the key signals has to analyse whether they will be difficult for a trainee and, where this is probable, attempt to provide further means of identifying them.

(iii) How far is it possible to provide any further indications for those signals? It is appreciated that any training procedure, however crude, does attempt to meet this problem. It tells the operator something about what to look for, which indicators are important and which are not. The complexity arises when the signals are not clearcut, when we are not dealing with pointer positions or light indicators but with changes in how a machine 'handles', when a control lever is said to become 'sticky' or has 'too much play'. How is the trainee to recognise these features? The most that can be done is to supplement the existing signals with accompanying signals, probably in another sense modality and generally employing some simple scale. A scale reading has the advantage that the operator can both interpret it immediately and remember it easily. But such additional signals, just because they are so effective, introduce their own problems in so far as the operator can now perform the task observing them alone without attending to the cues which are intrinsic to the task itself. Hence instead of learning the relation between the intrinsic and extrinsic cues, as is intended in such procedures, the operator merely relies on the new signals to aid his performance. Whilst he receives such additional knowledge his performance is satisfactory but once it is taken away and he is left with only the intrinsic signals arising from the operation itself he is lost.

This point brings us to the variety of uses to which the operator may be putting augmented feedback. If the response is of a ballistic kind which cannot be modified during its execution then the feedback is used to amend the response on its subsequent occurrence. But where it is a controlled movement the operator may use the signals to amend the response which he is carrying out. Again, if there are a series of responses then signals about the first response may be used as the basis for modifying the second.

In this context it is worth noting R. B. Miller's distinction between action feedback and learning feedback (Miller, 1953). In our discussion we have thought of signals both as additional cues supplied by the trainer and intrinsic cues which arise from carrying out the task. Such signals may be said to tell the operator what he should do as he continues the response or what he is doing at the moment, whilst others tell him only what he has just done. This is essentially the difference between action feedback and learning feedback, for action feedback allows the operator to modify his present response, whilst learning feedback, occurring after the termination of the response, can only indicate how the next response should be modified. This is much more than an academic distinction for experiments have shown that a subject's whole learning of the task is different in these two procedures. Consider a simple example. If one presses on a pair of kitchen scales it is possible by watching the pointer to exert an exact pressure, say 2 lbs. It may be possible, and the techniques of some trainers seem to suggest that it is possible, to learn an exact pressure by practising in this way. This would be an instance of the use of action feedback. On the other hand one may press and look at the pointer only when that attempt is completed; then having released that pressure begin again with a further attempt. This alternative technique corresponds to learning feedback.

This theoretical distinction, whilst illuminating, can be a little blurred in practice. For example, a subject who has used the dial to monitor his response in the previous example is still in a position to regard the dial reading as an indication of what he has just done. Individuals may vary to the extent that they may emphasise the monitoring aspect of the feedback, or perhaps not bother to look until they have completed the response. Similarly in rapid series of responses of the same type an indication of what has just been done will be more closely related to the succeeding response and will serve perhaps as the basis of this response. Hence action and learning feedbacks may in some circumstances tend to adopt the functions of the other and in this case removal of knowledge of results would result in a performance decrement appropriate to each case. It is interesting to note that in Macpherson, Dees and Grindley's work (1949) precisely this seems to have happened. With action feedback we predict quick improvement in performance and a sudden drop on the removal of feedback, and in learning feedback slower improvement and a slower fall off in performance. In the case of the experiment cited, rapidly succeeding trials showed a learning and removal of feedback a loss more consistent with action feedback. It is particularly interesting in so far as the authors themselves point out the difficulty which any one conventional learning theory has to account for their results.

The distinction between action feedback and learning feedback has brought out that with the human operator, in contrast to the engineer's communication system, the transmission problem is further complicated in so far as his immediate memory allows an overlapping of signals. Thus, though signals may occur in a certain time relationship, some may persist more than others thereby setting up new relationships. This is particularly relevant to knowledge of results which is given in an easily identifiable and retainable form so that the operator can manipulate such signals; that is, he tries to use them both for monitoring present performance and as a criterion for modifying responses in future attempts. Thus we have the paradoxical result that just because this kind of feedback is effective the operator may attempt to do too much with it. His training performance might be improved if he tried to do less and attended more to learning to correct past errors than to modifying present activities.

Though the distinction between action and learning feedback is not always clear-cut it would seem to be of theoretical interest and it certainly has practical importance. For example, on the basis of the above discussion, we would make the unusual prediction that by delaying feedback at certain points we may actually improve learning; that is to say by delaying feedback we ensure that the operator attends to what he has just done and does not attempt to modify his present response—we ensure that the signals operate as learning feedback.

MOTIVATION

It is axiomatic in many studies that knowledge of results will motivate trainees though it is rarely stated why this should be so. It is often implied that there is something intrinsically motivating about knowledge of results and it is discussed as if it were a second order of the law of effect. It is hardly necessary to point out that the giving of scores is likely to stimulate both social and self competition and indeed this competitive element often seems to be what some experimenters have meant by saying knowledge of results will motivate an operator. A point worthy of note is that few experimenters have stated explicitly what the goal of the subject is in any situation. Where improvement is the goal, knowledge of results by giving knowledge of goal achievement may be said to be 'motivating'. However there seems to be nothing contradictory in the notion that it is possible for a subject to have as his goal performance without such knowledge. It does not appear to be necessary to assume an intrinsic motivating factor in knowledge of results but that states of 'motivation' or 'frustration' may be manipulated by presenting goal achievement to the subject via some kind of knowledge of results.

But this is perhaps too much of a negative comment occasioned by a somewhat uncritical assumption on the part of many experimenters. There is the possibility that there is something 'naturally' satisfying about a situation in which the subject has some feedback and something naturally unpleasant about the situation in which the subject is deprived of knowledge of what he is doing. The experiments of Hebb and his associates indicate what happens in the extreme case where a subject is placed in what is very nearly a sensory vacuum. The experience is subjectively most unpleasant and has been likened to that of a psychotic illness. Whilst it would be unwise to generalise from an extreme case it is still a reasonable assumption that deprivation of feedback from a task in hand will tend to be an unsatisfying, if not frustrating, experience. As we have tried to suggest, it is so usual for an operator to receive some knowledge of results and so uncommon to be totally deprived of them.

SUMMARY AND CONCLUSIONS

We have attempted to outline our approach to skilled performance and its bearing upon how we can examine knowledge of results. It is apparent that knowledge of results may be used in a variety of ways and the trainer will have to be clear about these if he desires to introduce them. Where knowledge of results is introduced it is most likely that the trainee will attempt to use this augmented feedback but it is certain that how he uses it will vary from one kind of task to another and even within that task from one stage of training to another. We will try to summarise these points in a series of general statements. These are not intended as dogmatic assertions but as postulates which may be verified and accepted or rejected as necessary.

(1) It is convenient to regard an operator performing a task as a communication channel. The operator is receiving signals from his internal and external environment and on the basis of these signals he regulates his responses.

(2) The relative uncertainty of these signals may change during the course of training. In the initial stages there may be many random signals and the second and third members of a series may be as uncertain to the trainee as the first, but when responses tend to become stabilised then the later signals tend to become redundant.

(3) If we assume that the operator can to some extent appreciate the degree of redundancy of parts of the input and is prepared to react to signals which are less than certain, then this forms a sufficient basis for predicting a number of the common phenomena of skilled performance. By appreciating such redundancy the necessary information can be transmitted on the basis of less input signals so that the operator may improve either in speed of performance, or in anticipation, or, by attending to fewer signals, make the task easier for himself.

(4) An operator is always in receipt of feedback signals, and knowledge of results, augmented feedback as we have called it, is but another kind provided by the trainer. Such feedback is usually presented in some easily identifiable manner.

(5) Knowledge of results may be of different kinds some of which may be extrinsic but some intrinsic to the task.

(a) Results may take the form of an end score. This may serve as a neat summary of performance from which the operator has to draw his own conclusions about any deficiency in the skill. Such an end score may be an exact register of what has been attained but is often very inexact indicator of what precisely was right or wrong. The end score is of most value to the skilled operator who can interpret it in the light of his knowledge of the task; paradoxically he requires it least because from that same knowledge he can make an accurate assessment of what score he has achieved.

(b) Knowledge of results may take the form of an indicator for a particular signal which is difficult to detect. This can be especially valuable in the early stages of training in delimiting the area of search.

(c) Knowledge of results may be in the form of accompanying signals within the operation. The operator does not always realise that some intrinsic signals occur as a result of his own responses. For example in driving, when starting a car on a hill as the clutch is beginning to make contact the engine note changes although the car is still stationary. The trainee should be made aware of the signals which are intrinsic to the task and be taught how to use them.

(6) In common with other signals knowledge of results may be put to a variety of uses. One distinction lies between those signals which tell the operator what he should have done, learning feedback, and those which tell him what to do next, action feedback. This is R. B. Miller's distinction and whilst it is useful it is not always clear-cut. Characteristic examples of this use are where feedback serves (a) to enable the operator to amend the same response in a future trial (learning feedback), (b) monitor a present response (action feedback), and (c) adjust subsequent responses in the same series (action feedback).

(7) Such usages are largely determined by the task in hand. Example (a) above is common where the operator is making a single discrete response. Example (b) above is more likely in an extended response involving several adjustments as in a controlled movement when applying a precise pressure. Example (c) is not dissimilar to (b). If we think of the series as involving responses, *x, y, z,* the operator on observing some inadequacy in *x* when performing *y* tries to adjust responses *y* and *z* accordingly. This tends to teach him little about *x* and makes responses *y* and *z* more difficult than perhaps they need be.

(8) Since knowledge of results is given in some easily recognisable form it is important to note that where it is being used to identify less distinguishable intrinsic signals the operator does not come to rely on it alone. Where external signals become an end in themselves rather than a means to an end of identification the operator tends to be lost when they are removed. This is particularly the case where a task involves ill-practised responses and the trainee tends to rely on the extra signals where, as in (6c) above, there is a series of responses and he is attempting to modify one of them because of deficiencies revealed in the last result.

(9) Because of the variety of uses to which knowledge of results is put its removal may have a number of different consequences.

(a) In those cases where the operator is carrying out a series of well practised responses removal of knowledge of results will not lead to a sudden fall off in performance. Conversely where a response is not well known the fall off will be greater.

(b) Where a subject is using knowledge of results as action feedback the fall off will be more dramatic than where he had been using it as learning feedback.

(10) Though it is inevitable that in some cases knowledge of results is used

as action feedback in the early stages of training, it is essential that this does not continue if such knowledge will not be given in the operational situation. Probably the surest method here is to withdraw knowledge of results on some trials during training, say on alternate trials or blocks of trials.

(11) Motivation. Knowledge of results does encourage both self- and social-competition. In so far as it is normal to receive feedback when making a response we might expect a situation in which the operator is denied knowledge to be frustrating. There need be nothing intrinsically motivating about knowledge of results but in so far as its removal militates against goal attainment its removal will be frustrating.

ACKNOWLEDGMENTS

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The Transition from Work to Retirement (I)

By MARGARET PEARSON

This study was undertaken by the Department of Social Science, University of Liverpool, in a large Liverpool manufacturing firm. The Department wishes to acknowledge the continued co-operation of this firm and its employees in research, which has extended over a period of years. The fieldwork and the preparation of the first draft of this report were undertaken by Mrs Pearson. Miss Penelope Hall and Miss Doris Read provided considerable guidance and advice, and Miss Hall edited the final draft. In this first paper a report is made on the aspects of the study numbered (1) and (2) below. A second paper will cover aspect (3).

OBJECTS AND METHODS OF THE STUDY

OF recent years there has been a good deal of discussion on the policies which should be pursued both nationally and by individual firms with regard to the retention of elderly workers beyond the minimum age at which the state pension is payable. Much depends on the abilities and attitudes of the workers concerned, and this article describes a study made of the capacity for work and the attitudes towards retirement of 220 men who were between 60 and 65 years of age when the investigation started in 1951 and were employed by a Liverpool manufacturing firm with a fixed retirement age for all its employees. Its object was to discover the ability and willingness of the men to remain at work after the normal retirement age and the conditions under which they would be prepared to continue. A follow-up investigation was undertaken two years later in order to discover how those who had given up work meanwhile were adjusting to their retirement. The study thus consisted of three parts:

(1) An examination of the employment record from the age of 45 years onward of each of the 220 men in the sample.

(2) An investigation by postal questionnaire* of the attitudes of these men towards retirement and, in particular, whether they considered any changes in the firm's existing policy of a fixed retirement age desirable.

(3) A subsequent attempt to ascertain, by personal interviews based on a questionnaire, how those who had retired were adjusting to their retirement, and, in particular, whether they had obtained or were seeking other work.

It was hoped that in these ways a fairly complete picture of the closing years of the working life of a group of industrial workers would be obtained, and some knowledge gained of the impact of retirement on them.

THE FIRM, ITS WORK, AND ITS POLICIES WITH REGARD TO OLDER WORKERS

The firm in which the 220 men worked is an old-established family business which, after migrating from North Lancashire to Liverpool in the

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*A postal questionnaire was used for this part of the investigation as it was thought that interviews during working hours would unduly dislocate the work of the different departments where the men were employed, especially as a few months earlier work had been interrupted by another survey which involved interviewing disabled persons.

1880's, entered the seed-crushing industry and now manufactures a wide range of products, the main ones being animal feeding stuffs, vegetable oils, lecithin, soap, glycerine and compound cooking fats. It employs about 3,500 people in the main factory in Liverpool (4,000 if the head office staff is included) and it has acquired other factories elsewhere. Although it became a public company in 1951 it is still very largely a family affair, most of the directors being descendants of its founders. The family has a long-standing reputation as a progressive employer, providing good general conditions and welfare facilities, and industrial relations have always been peaceful.

At the time of the survey the total labour force employed at the Liverpool factory was 3,529, only 511 of whom were women; 64% of the men were engaged on production processes, 24% in the trades and transport departments and 12% on the supervisory, technical or clerical staff. The work is predominantly unskilled or semi-skilled. Its physical demands were assessed by the Job Evaluation Officer in 1949, and the proportion of men in the different categories at the time of the survey was as follows. (The jobs were evaluated not only for the assessment of wages but also to facilitate the better placing of the firm's workers according to their abilities. Each production job was examined and placed in one of the categories listed.)

Physical Demand	*Per cent. of Jobs*
Heavy	11
Medium-with-heavy	8
Medium	32
Light-with-medium	37
Light	10
Extremely light, sedentary	2
	100

In some departments, for example, those where manufactured meals and pellets are handled and bagged, the work may be dusty as well as heavy, while the design and size of the building in the older part of the factory make the use of labour saving devices difficult so that a considerable amount of carrying and humping of sacks and pushing of two-wheeled trucks is unavoidable. This carrying, humping and trucking accounts for a good deal of work in the heavy and medium grades. Light-with-medium work includes trucking, general packing, hoisting, some machine jobs and plant cleaning. The two lightest grades include the majority of storekeepers, cleaners, clerks and checkers and a few machine workers.

The main production departments of the firm work on shifts, but in the trade and transport departments day work predominates. In July, 1951, the time of the survey, the basic rate of pay for a day worker was 118s. a week.

The average age of hourly paid workers has increased since the beginning of the last war, and at the time of the survey 42% of them were 45 or over. This is due to the fact that during the war older and less fit men were recruited to take the place of those who left for the Services. Although younger men were afterwards engaged labour turnover among them was high, and hence of late the firm has tended to select older and preferably married workers as these are more inclined to settle.

The firm's policy towards its elderly employees is generous. Every possible attempt is made to transfer to less exacting work those who feel that their jobs are becoming too much for them, and if a man under sixty is transferred to a lower rated job or from shift to day work at the instance of the Company 'for reasons of either redundancy or disability' his wage is not suddenly reduced to the rate of the new job, but goes down 3s. 6d. every six months. Reduction begun before the employee reaches sixty ceases at sixty, and a man who has reached the age of sixty (in the case of a woman the age is 55) and who is subsequently transferred to a job carrying a lower rate of pay, continues to be paid at his previous rate. Many elderly workers also benefit from the Works Staff Scheme, which was established so that certain hourly paid workers could become eligible for most of the privileges enjoyed by the clerical, supervisory and technical staff. These include full pay for a period varying from six to twelve months, according to service, in the event of accident or sickness, increased holidays and no loss of wage for lateness or authorised absence. All employees over fifty-five years of age are granted an extra week's holiday with pay, and are encouraged to submit themselves for medical examination at regular intervals. In these ways the firm, in its employment and welfare practices, does much to recognise the special problems of older employees.

Among the benefits introduced for its workpeople are the firm's two pension schemes. Both are non-contributory and are based on length of service and the employee's wage on retirement. In addition to their pensions, retired employees receive a few minor benefits including a Christmas grant, and there is an annual reunion and party. There is a special fund from which compassionate payments may be made, and pensioners are entitled to attend the Company's dental and chiropody clinics though in fact few do.

(I) EMPLOYMENT RECORDS OF WORKERS FROM THE AGE OF 45

Work changes

The extent to which workers ease off during the latter part of their working life can be gauged to some extent by studying the moves they make from heavier to lighter work and from shift to day work as they grow older. Of the 220 men in the group studied, 115 worked in the production departments and 78 in the trades and transport departments. Work changes in these two groups are considered separately as conditions of work differed.

(*a*) *Production Departments*

A study of the employment records of the 115 men in the production departments revealed that between the ages of 45 and 60-65, 63 of them moved to work graded as less exacting in its physical demands than that in which they had previously been employed; of these 42 were from the three heaviest grades. On the other hand eight changed over to heavier work, though none of these eight were in the three heaviest grades; while

44, while they may have changed their jobs, had not moved from one grade to another. It is probable, however, that some of these 44 were in fact doing less demanding work in their sixties than in their forties, since there is a tradition in the factory, accepted by men and management alike, that older workers should be allowed to 'ease-off' by avoiding the heaviest jobs, taking more time over their work and having more frequent rest pauses.

It had been expected that most of the transfers from the heavier to the lighter grades would take place after the age of 60, since after that age a man transferring to a lower rated job may retain his established rate of pay, but on examining the work histories of the 42 men who moved from the three heaviest grades after the age of 45, it was found (as shown by the following table) that transfers took place at all ages and that moves from these three grades often took place in two or more steps (*e.g.*, age 45, heavy work; age 55, medium work; age 60, light-with-medium work). Almost three quarters of the group did not make the last transfer until after the age of 55 however. Twenty-seven per cent postponed their first and 40% their last move until they were over 60.

	Age 45-49	*Age* 50-54	*Age* 55-59	*Age* 60+	*Total*
First transfers to lighter work	18	14	14	17	63
Last transfers to lighter work	7	10	21	25	63

The tendency to transfer from heavier to lighter work with advancing years was accompanied by a gradual change-over from shift to day work. At the age of 45 only 27 men (23% of the group) were on day work, 88 (77%) being on shift work, but by the time these men reached the ages of 60-65 the proportions had been reversed, and 69% were on day work compared with 31% on shifts. As many as 52 men transferred from shifts to day work after the age of 45, but not one moved in the reverse direction, and a detailed study of the records showed that about two thirds (33 out of 52) made the change before reaching the age of 55. By relating these moves to moves from heavier to lighter work it was found that of the 88 men on shift work at the age of 45, only 14 did not transfer either to day or to lighter work, and of that number 8 were already on light jobs. Of the 74 men who did move to other jobs after the age of 45, 22 remained on shifts but transferred to lighter work, 32 transferred to day work which was also lighter, and the majority of the 20 men who transferred to day work in the same grade were already on light work. Of the 27 men on day work at the age of 45, 10 men transferred to lighter work and 11 of the 17 men who did not move were already on light work.

(*b*) *Trade and Transport Departments*

In these departments there were fewer job changes after the age of 45 than in the mill. All the 29 tradesmen and 22 of the 49 semi-skilled and unskilled men were doing the same jobs at 60-65 as at 45, while of the 27 who had changed their jobs, 16 had transferred within the trades departments and 11 had transferred from production. Detailed examination of the records showed that only 12 of the 78 men in these departments had moved to jobs graded as light by the Job Evaluation Officer, while 5 had moved to heavier ones. All moves took place before the age of 60. The fact that there are fewer changes in these departments is probably due to the fact that the work here is less heavy and more individual than in the mill. For the most part the men can control the pace of their work and the distribution of rest pauses, and a considerable variation of effort is therefore possible.

The majority of jobs (87%) in these departments are day work and hence there are more opportunities for older workers wishing to undertake this type of work than in the mill. At the ages 60-65, only 15 men, of whom 12 were in the Traffic Department, were on shift work, 11 had changed from shift to day work after reaching the age of 45, while 7 had made the reverse move (1 on becoming a chargehand, 3 on transfer from production and 3 in the Traffic Department).

The circumstances under which a man changes his job and the factors which influence him in coming to this decision vary from person to person and are not always easy to assess, especially when, as in this survey, the men were not interviewed personally and the firm's records did not always indicate the reason for transfer. Those responsible for placement gave it as their opinion that transfers to lighter or day jobs were often expedited directly or indirectly by disability or illness. Permanent disability was indisputably the reason for the move in some cases; in others a man might move as the result of a temporary illness or injury and never return to his former job. (Of the 63 men in the production departments who transferred to lighter work after the age of 45, 30 were disabled, and out of the 12 who transferred in the trade and transport departments, 5 were disabled.) Others again were recommended for lighter work as vacancies arose or their jobs became redundant, while some made formal application for lighter or day work in the belief that it was right and wise to do this before the necessity for transfer actually arose. It would seem, then, that transfer was often preceded by a period of increasing awareness of strain on the part of the men themselves or their supervisors, even where there was no evidence of definite disability or illness, but a chance circumstance might determine the exact time at which the change was made. Social and financial considerations also help to determine the time of the change, however. For instance, some men said that as their children grew older and left school the extra shift allowance became less necessary and they were in a position to change to a more regular and less exacting routine which would enable them to spend their evenings with their wives, now released from the more onerous burdens of child care.

Attendance and Time-Keeping

Among questions frequently raised in discussions about the employmen of older people are those connected with frequency of absence, time-keepin and liability to accidents. This investigation included an examination o the absence and time-keeping records for the previous two years of the me between 60 and 65, and an attempt was made to compare them with averag for all ages. Accident rates were not studied, as it was thought that, as many of the older workers were engaged on lighter and easier jobs than those of the younger men, the risks were not comparable.

The average number of working days absent during the year for the group of older men studied compared reasonably well with the average for all ages for both the years 1950 and 1951. In 1950 it was 14 working days, compared with 16.8 working days for all hourly paid employees, and the higher average (21.4 working days compared with 17.5 for all employees) in 1951 may be accounted for in part by the influenza epidemic in the latter year. When the records were analysed further it was found that in 1950 42% of the group had no absences over the period, and a further 28% absences of less than 15 days, the corresponding figures for 1951 being 37% with no absences and 22% with absences amounting to less than 15 working days.

Frequent absences for short periods cause more trouble in a works department than do continuous spells. Hence the number of periods of three days or more, and the number of odd days, during which each of the 220 elderly men studied was absent from work in the two years 1950 and 1951 was ascertained. In 1950 only 20%, and in 1951 26%, of these men had more than one period of absence, and as many as 81% in 1950 and 90% in 1951 had no odd days away from work. This tends to show that such absences as did occur were unavoidable and that the men had a responsible attitude towards their work. This is confirmed by the fact that more than half the group were never late without a good reason during the two years 1950 and 1951, and only 3% in 1950 and 1% in 1951 were late more than 15 times. They were much better time-keepers than the younger men.

(2) ATTITUDES TOWARDS RETIREMENT

The second part of the attitude survey consisted of an attempt to ascertain the attitudes towards retirement of the men whose work-records have been analysed in the foregoing section. By the firm's ruling they were all due to retire at 65. They were asked, first, whether or not they were in favour of a fixed retiring age; and secondly, whether or not they personally wished to continue working beyond this age together with the reasons for their preference. Those men who stated that they would like to continue at work were questioned regarding the conditions under which they would prefer to work.

The questionnaire was completed by 171 out of the 220 men whose work histories had been studied, and 61% of these thought that the firm should continue to have a fixed retiring age. They differed somewhat as to when this should be, as shown by the following table, but 41% of the group wanted it to be 65 or under.

Suggested Retiring Age	*Number*	%
Under 65	26	15
At 65	45	26
70	29	17
75	3	2
Yes, but no age stated	2	1
No definite retiring age	66	39

A number of those who commended a fixed retirement age stated that they themselves did not want to give up work altogether at that age, and in reply to the question regarding their willingness to continue at work after the age of 65, 117 or 68% of the group said they would like to do so, the majority for as long as they felt able. There was some difference in this respect between the different departments; only 50% of the men in the technical and supervisory grades said they wished to go on working, but this proportion rose to 67% among the men working in the mill and as high as 77% in the trades section.

The majority of the men who wished to retire put forward health reasons. These included not only men who were known to have a definite physical disability (27 out of the 55 disabled persons in this group were ready to retire at 65), but also a number who felt that on health grounds they could no longer manage the work required of them and who made such comments as: "Under the conditions of work in this factory I don't think it would benefit my health to work any longer." "I have given of my best and I just couldn't keep up the pace." It is clear from the second quotation that consciousness of strain may be accompanied by the feeling that after many years of hard manual work, starting in some cases before adolescence, for these older men left school early, the worker deserves a rest. As one man expressed it, "After being with the firm for 51 years I feel that I will have deserved a rest, especially as I have heart trouble."

The other reasons given for preferring to retire as soon as possible were of minor importance. Only two men felt that they should retire in order to avoid blocking a younger man's promotion, which is not surprising in a group consisting so largely of unskilled and semi-skilled men, and very few said they wished to retire in order to follow some other interest while still young and fit enough to enjoy it.

The reason for preferring to remain at work after the age of 65 which was most generally given was that retirement would bring some form of economic hardship or at least a reduction in standards of living. Fifty-five per cent of the men who returned the questionnaire thought that the combined firm's and State pensions would be insufficient to meet their needs, while a further 16% did not know whether or not they would be sufficient. Hence, those who were fit felt that they should continue at work as long as they were physically capable of doing so. When the follow-up survey was made two years later very few men were found to be suffering from financial hardship, but in a number of cases this was due to the fact that household expenses were being shared by children who were earning. Thus it appears that this anxiety was not without some justification.

The intangible but very real fears of old age, loneliness and boredom, were evidently already present in the minds of at least some of the men in the group, and may be summed up in the words of the man who wrote, "Working keeps you fit and occupies the mind. In any case I'd miss the other men so much if I retired." However, although no precise figures can be given, such worries were mentioned much less frequently than fears of financial loss.

Of the 117 men who said that they would like to go on working after 65, 61 were working in production departments, 44 in maintenance departments, 11 were supervisory or clerical staff and 1 man was a farm worker on one of the firm's own experimental farms. It was found that 88 men (75% of the group) were on day work and 29 men (25%) on shifts. The grades of work on which they were engaged were as follows:

Grade of Work	*Mill*	*Trades*	*Staff*	*Farm*	*Total*	
	No.	*No.*	*No.*	*No.*	*No.*	*%*
Heavy	2	—	—	—	2	2
Medium with heavy	2	2	—	—	4	3
Medium	6	28	—	—	34	29
Light with medium	32	15	—	—	47	41
Light	17	—	—	—	17	14
Extremely light and Sedentary	1	—	—	—	1	1
Unclassified	—	—	11	1	12	10
	60	45	11	1	117	100

When asked about the jobs they wanted to do after the age of 65, 74 (63%) of the 117 men in the group answered that they would like to continue in the same work, but 14 (12%), whilst quite prepared to continue in their present jobs, said they would really prefer a different, and in most cases a lighter, job with the same firm. On the other hand, 29 men (25%) said definitely that they did not want to continue in their present jobs after 65, 11 because they felt that it would be too heavy for them, and 18 either because they felt like a change or because they wanted different working conditions such as work in the open air, away from dust or heights, sedentary work or work with less responsibility. Of these 29 men, 16 said that they would prefer another job with the same firm, and it is evident that the majority of the men who wanted to work on after 65 wanted to stay with the same firm rather than start afresh somewhere else. However, 98 of the 117 said that if it were not possible to do this, they would take a job elsewhere if they could procure one which was suitable and within easy reach of their homes. Only 14 men (12%) stated that they would be unwilling to work elsewhere and 5 men (9%) did not know what they would wish to do under such circumstances.

When the men were questioned about the kind of jobs they would like to do if they were to start work with another firm, nearly all the skilled men and some of the semi-skilled maintenance workers replied that they would prefer to continue in the kind of work they were then doing. The unskilled workers were on the whole rather vague about the exact job they would like to do but most of them wanted light or fairly light work, involving no time-stress or group pressure. Examples given were a groundsman, part-time farm labourer, night watchman, clerk, caretaker, cleaner, storekeeper, messenger, machine-minder and dressing-room attendant.

On being asked whether, on reaching the age of 65, they would be prepared to train for a new job, 33 (28%) replied in the negative and 13 (11%) were not sure. This left 71 (61%) of the men concerned who stated that they were prepared to train, but a few of these qualified their answer by saying that this would only arise in the event of their being unable to procure a suitable job for which no training was required, and from the general tenor of the answers given to this and the previous question, one gathered that training for a completely different kind of job was regarded as a last resort.

The desirability of modifying hours and conditions of work for men above retirement age, even to the extent of segregating them in a special workshop, is among questions which face industrialists who are contemplating more extensive provisions for their older employees, and little is known about the preferences of the workers themselves on these matters. Considerable differences of opinion were found among the men in the sample. For example, of those wishing to continue at work, almost the same number (44%) stated that if they were given a choice they would prefer to work with elderly people, as those (47%) who expressed a preference for working with people of varying ages; 11% did not know which they would prefer and, while 53% thought they would quite like to work in a special workshop, 34% did not like the idea and 13% expressed no opinion.

Three-quarters of the group who wanted to go on working after the age of 65 were already engaged on day work at the time of the survey; all these wished to continue on day work, while 34 of the 45 shift workers questioned wanted either to change to day work or retire at 65. While emphatic in their preference for day work, the majority of the men who wished to remain at work were prepared to work the usual hours but about a quarter of them mentioned that they would like a shorter working day than at present, possibly coming in half-an-hour later and leaving early. There were, however, 12% who expressed a preference for part-time work of three or four hours daily. Preference for the five-day week, which had been the pre-war practice of the firm, was expressed by 59% of the men, but of the remainder, 29% were prepared to work a full 5½ day week and only 7% wanted their working week reduced to two or three days. Similarly, the great majority were prepared to work the whole year round. Only 10 men said that they wished to work certain months only, and 9 of these made this stipulation because they thought that their health would prevent them from working during the winter. By examining these preferences regarding hours and days of work together, it was found that 71 men or 61% of the group were ready to work a normal working week all the year round and 18% felt that they could manage with minor alterations such as a slightly shorter working day. However, 25 men (21%) wanted a greater reduction in their times of work, some being prepared to work for part of the week and some for only part of the year.

A question about expectations as to earnings if work were continued after 65 was included, but an appreciable number of the men were reluctant to commit themselves on this point. As many as 32% did not answer the question at all, and those who did gave rather vague replies. From the information received it appeared that those wanting to work part-time expected to earn amounts varying from £2.10.0 to £4.0.0 a week, while those prepared to work full time or for slightly shorter hours expected to get the Union rate for the number of hours worked.

Training in Industrial Skills: Opinions of Trainees

By D. C. S. WILLIAMS

This is a shortened version of a report on one aspect of a study which formed part of an enquiry into methods of training in industrial skills. The research was sponsored by the Joint Committee of the Medical Research Council and the Department of Scientific and Industrial Research which deals with Individual Efficiency in Industry; it was financed from Counterpart Funds derived from United States Economic Aid; and it was carried out by the National Institute of Industrial Psychology.

INTRODUCTION

THE results of an experiment on the effects of competition between groups in a training situation have been reported (Williams, 1956). Briefly, the task of relay adjusting was taught in ten-day courses, in each case to a class normally consisting of sixteen students. In the experiment, 'competition between groups' was introduced into the even-numbered courses of a series of eight, and the odd-numbered courses were used as controls. While that work was in progress the opportunity was taken of gathering information from the trainees about their opinions of and attitudes towards training courses. It was hoped that something might be discovered about the motivation of learners, and that this knowledge could be used to plan further experiments. This paper describes the method used for the opinion survey and reports the results.

We were trying to get answers to questions like the following: Why does the learner try hard to master this task? Is it because he sees future advantages in pay or promotion if he should do well on the course? Or is it for the sake of personal satisfaction in doing his best? Is it for fear of trouble later on if he should not have done well? Is it because there is intrinsic interest in the task. Or, if he does not try very hard, is it because he finds the task uninteresting? Or simply that he thinks it will make no difference to him whether he should pass or fail the course? A very large number of questions along these lines come to mind, and the problem was to know which were the important ones.

THE PLAN

Choice of method

The time available was limited and ruled out the possibility of individual interviews with students. The use of a questionnaire was considered. But it seemed that to be of any value a form would have to be so comprehensive that it would take too long to administer and more time than could be spared for its design. We wanted a method that would be economical of time and that would allow students to mention the things of importance to *them* rather than to remark upon topics which *we* thought might be significant. It was decided therefore to ask them, by means of a prepared explanation which would be used for all the courses, to make free written comments about training courses. A copy of this instruction is shown as Appendix A, and it will be seen that students were asked to do two things: to write down any comments or opinions they had about training courses in general, and also about the particular course they were at the time attending.

We had at this stage no idea what response to expect. It was, however, thought likely that some controversial points would emerge, and also that some topics, on which all might be expected to have an opinion, would in fact be raised by only one or two members of a group. A second stage was therefore planned: after reading the comments of a group the investigator was to pick out those that were controversial or isolated in the sense just described, and to obtain the group opinion on them. This was to be done by reading them aloud to the whole group, who would then be asked to mark, on the forms provided, Strongly Agree, Agree, Uncertain, Disagree, or Strongly Disagree.

Administration

Each course lasted for ten working days. It was arranged for the investigator to attend on the ninth morning of each course to obtain the written comments of the students. He was to return the next morning having made a list of controversial or isolated remarks on which to get the opinions of the group. A class-room with blackboard and writing tables was provided and there the senior instructor handed over the students to the investigator who then explained his procedure in the standard manner. This was done for six courses attended by a total of 92 students.

The students

The students were maintenance engineers of a semi-skilled level who receive training in various aspects of their job by courses at a central training school to which they are sent from their places of work anywhere in the home counties. All had previous experience of attending such courses. Typically they had left school at 14 or 15 years of age, and had had no further education, though a small proportion was keen enough to have attended evening classes in technical subjects. The average age was 30, and the range extended from the early twenties to the mid-fifties. We could not expect from a population of this kind verbal fluency of a high level and we took a risk in asking them, with a minimum of guidance, to make free written comments.

The response

In the event the amount of written comment was far more than had been expected. Our assessment of the students' ability to express themselves on paper was altogether too pessimistic, and they seemed to welcome the opportunity to give their opinions of training courses and methods of instruction. It had, of course, been made clear that the investigator was from outside their organisation and would treat anything they said as confidential, reporting only anonymously and in general terms.

Method of analysis

Considerable difficulties arise in attempting to classify completely free comments. Inevitably a great deal of what is said or written is irrelevant, and often so vaguely phrased that it is difficult to decide just how irrelevant. If the comments are obtained at interview, follow-on questions can be asked to clear up doubtful points, but with written comments that is impossible. A further difficulty is to place comments into exact categories except by having so many categories as to defeat the object. Nor did it seem helpful in this case to report results in the form, "*x* per cent. said such-and-such; *y* per cent. said so-and-so." The attempt has been made therefore to discuss from a qualitative rather than quantitative point of view those comments which seem relevant to learners' motivation.

Any opinion about any aspect of training was taken to be a comment. Thus, a comment may be expressed in one short phrase, as: "A good course." Or more than one comment may be contained in a sentence, as: "The instructors are first-class but are handicapped by red tape." Here are two comments, a favourable one about the instructors and an unfavourable one about, presumably, higher authority. On the other hand a whole paragraph may only contain one comment, as:

> "I have found a tendency to doze off during lectures. I mentioned this to one of the instructors who was of the opinion it was the instructor's fault for not making the lecture interesting enough. I am inclined to disagree as I have now taken quite a number of courses, both at ...... and in the R.A.F., under a large number of different lecturers and have found the same tendency on every course."

This is regarded as one comment to the effect "When attending a lecture on any course I tend to doze off." It is also an example of the kind of statement that is hard to classify. It is not easy to decide whether it should be regarded as favourable or not, as irrelevant or not.

RESULTS: FIRST STAGE

COMMENTS RECEIVED

The number of comments received from the 92 students was 687, divided as follows: courses in general, 317; this course (*i.e.*, the course they were at the time attending), 370. Classified broadly according to topic, they were:

COURSES IN GENERAL	NUMBER OF COMMENTS
Favourable to courses in general terms	98
Incentives: pleasant or disagreeable features of courses	76
Practical suggestions and critical comments on programmes and methods	58
Selection of students for courses	60
Other topics	25
TOTAL	317

THIS COURSE	NUMBER OF COMMENTS
Lighting, eyestrain and mental strain	57
Instructors and instructional method	55
Syllabus and programme; selection of students	49
Students' motivation	36
Tools and equipment	35
Physical working conditions; training school amenities and atmosphere	34
Length of course; monotony and boredom	34
Marking system	13
"On the whole this is a good course," or similar comments	30
Comments in favour of a course on this topic	13
Miscellaneous	14
TOTAL	370

DISCUSSION OF SPONTANEOUS COMMENTS

The comments on 'this course' tended to be on specific points while the 'courses in general' comments were more general. This was to be expected; the men were just reaching the end of a ten-day course, and all the detail of its administration and methods of work, and their feelings about the task, its difficulty, pleasantness or otherwise, were fresh in their minds. When commenting on 'courses in general' however they were relying on memories of a number of courses, on the general impression left after the detail had become blurred.

Courses in general

Favourable to courses in general terms. This heading covers the greatest number of comments. It is noticeable that practically every student made some such remark though it was often followed by specific criticisms or suggestions for improvements. No doubt the first example given by the investigator (see Appendix A)—"It's a good idea to go on courses because . . ."—contributed to this result, and it was perhaps unfortunately phrased. The comments varied from the simple: "Courses are definitely a good thing" to the more elaborate statement: "I believe courses are useful in improving the general standard of work, especially refresher courses, as one tends to get rusty on certain aspects of one's work in time, *i.e.*, you tend to forget certain technical details or forget to carry out certain practical details, and a refresher course helps to bring you up to scratch again." Or again: "On each course I have had there is something or other which I have learned, whereas if there were no such thing people employed in the department would not have so much confidence in being able to really tackle the job which they are doing." It seemed that everyone could find some good in courses. For instance: "They give a chance to meet members of other staffs, which is refreshing, and although the technician may be quite happy at his headquarters, a change of scenery and colleagues for a while seems to be a good idea, even if he is not keen on the course. After all, a change does everybody good." In spite of the criticisms, to be discussed under various sub-headings below, it was clear that the attitudes expressed towards courses were overwhelmingly in their favour. This is not surprising since all these men had attended previous courses of one kind or another, and the successful passing of specified courses is required before they are considered for promotion.

Incentives: pleasant or disagreeable features of courses. The broad heading of incentives groups together the next greatest number of comments. In some cases the motivational element in these comments is slight, although they do indicate that the course situation was seen to hold some incentive; or, conversely, it was considered worth noting that courses do not provide any incentive. The term 'incentive' is not here confined to financial rewards, although some of the remarks refer to these. This category is perhaps best described as consisting of comments which indicate factors, either internal or external to students, which seemed to them to make it worthwhile to attend a course and to put some effort into its work; or, negatively, factors which seemed to make it not worthwhile to attend courses or to work diligently on them. The comments will be considered in sub-groups according to the topics mentioned.

Makes the job easier and gives interest and confidence. The fourteen comments in this sub-group are represented by the following: "I like courses because I picked up my trade rather than having been taught; and the proper way of doing things is not only better, but often easier." "Work is made easier as less trial and error is involved." "It helps you to carry on with your work in a more efficient manner and to have confidence in yourself when doing so." "The main point perhaps is that I am given a greater interest." These comments go rather beyond those noted under the heading 'favourable to courses in general terms' in giving more specific reasons for approval; and these reasons appear to be less superficial and stereotyped and to reflect rather more the actual feelings of the students. The six items in the next sub-group are similar.

Self-dependence. "A student or workman taking a course can feel that if he is successful or otherwise it is entirely dependent on himself." "It is worthwhile working hard on a course even if it is only for the satisfaction of succeeding." These represent the rather small number of comments which imply that, though there may be no tangible advantages, there is a personal satisfaction to be gained from course work. However, attendance on training courses is one of the accepted terms of their employment, and by expressing approval they were merely assenting to the social attitude demanded by their working environment. This is to the effect that courses, on the whole, are well worth while, although they may not always in practice measure up to ideal standards.

Promotion prospects. Seven comments refer to this topic, and suggest that passing a training course enhances the prospects: for example, "I feel that all courses to do with your particular job are essential if you are seeking promotion, therefore I accept all offered." "The greater my knowledge and skill the greater are my chances of promotion and therefore increase in pay."

Social factors. Half of the comments under this head, were positive and half negative. Representing the positive ones is the following: "One great advantage of these courses is that they give you the chance of meeting fresh faces and making new friends." The other point of view is represented by: "I have no desire to be away from my wife and family for weeks to attend a course." The total comments on social factors numbered only eight, and no doubt depended a good deal on the circumstances of individuals. There is an indication, however, that at any rate some students' attitudes were affected by location of the course, particularly if it took them away from home.

Lack of promotion. Turning now to comments about the lack of incentives on courses, which are more than half of those placed in the broad 'incentive' category, the first few complain that promotion is not sufficiently dependent on diligent study. "It would be a good idea if a hard and fast rule were made stating that having passed a certain number of courses promotion would be gained." "If a clear advantage to the pupil in the way of advancement can be seen, interest is greater." "One can study till the cows come home and pass exams and courses and still not get promotion." These statements represent the eight in this group.

Lack of financial reward. A dozen comments refer to the lack of any immediate financial benefit; for example, "A cash award for a first grade pass would serve as an incentive."

Lack of recognition. The following comment states what was hinted at by a number of others. "The average student attends because he is sent, but fully realises that it will not be taken in full favour if he fails nor will he be praised if he passes. He receives no individual pat on the back (a thing we all seek occasionally) but a slip of paper stating 'I am pleased to inform you.' Who is pleased?"

Lack of incentive. Most of the adverse comments, however, do not particularise but complain in general terms. "Most courses suffer from lack of incentive." "No real incentive to do one's utmost." "I don't think it's worth working too hard on a course because there are no benefits. If one becomes highly qualified there is no gain." "There is absolutely no incentive given to men who are successful in passing courses."

Practical suggestions and critical comments on programmes and methods. This category, which includes also observations on the effectiveness of instructors and methods of instruction, contains fifty-eight comments, generally critical in tone. They range from statements like: "The instruction in some classes could be given with more enthusiasm than it is instead of the job of work fashion in which it is administered." "The general standard of instructional technique is poor. There are a few exceptions, mainly ex-Service instructors," through comments on the tools and equipment such as: "Sometimes tools are not in very good condition," to practical suggestions about the length of courses and the planning of programmes: "Some of the courses are far too short." "Courses should be kept to a short period." "Courses which cover theory and practical spend too much time covering theory ground that is given elsewhere, *i.e.,* at technical school. The theory given is either known by the students, which makes the course boring, or it is not known, in which case the course is far too sketchy to be of any value." "Most courses make a lot of fuss over official instructions and students are found to adopt methods in the practical work which would never be used outside the course."

Selection of students for courses. Sixty comments altogether were placed in this category. Broadly, two distinct points emerged. First, that efforts should be made to send on any course men of equal experience: for example, "The main trouble I find on most of these courses is that the whole class is mixed. . . . Half of the class have been doing this work every day and others have done little or none at all." The second and more important point was that men sometimes are sent on courses inappropriate to the work on which they are engaged: "We are sent on courses at the wrong time, i.e., I was sent on X course two years after I had finished doing X." "I think you should take courses in a set order, as sometimes you get a chap doing an advanced course before he has done the first preliminary." "Courses are a good thing providing people go on courses which are of value to them directly." But, although this was the majority view, there were a few dissentients; for example, "Although the particular course you may go on does not at the time of taking it have anything to do with the kind of work you are doing at the time, in my opinion a little knowledge of everything is far better than a lot of knowledge of just one particular section of the job."

Other topics. From the remainder of the comments it is necessary to mention only one which relates to the contrast between working conditions in the training school and on the actual job. Difficulty in obtaining correct tools was alleged as well as disparities between common practice and the methods advocated during training. "A greater co-ordination between the schools and the actual place of working is needed."

This course

As mentioned above, comments on 'this course' refer to more specific points. Since many of these are of little interest except to the authorities concerned they will not be discussed at length. At the same time it would be wrong to dismiss without examination comments on, say, the marking system or physical working conditions, for it is clear that in some cases they were prominently in the students' minds.

Marking system. One comment was: "The system of marking has a large bearing on the attitude of the students." In fact, the number of remarks on this topic is small, and it is perhaps inevitable that a minority of students will feel anxious whatever system is adopted. However, that these anxieties do arise is shown by: "Too much stress is laid on marking, which is inclined to make several students feel they will never pass the course." On the other hand, one comment said: "The marking of relays was quite fair."

Tools and equipment; and physical working conditions. In general the comments under these headings were favourable: "Tool kits were generally speaking in reasonable condition." "I have taken two other courses and from what I can remember of them the building or tools were nowhere up to the standard of this course." Critical remarks mostly refer either to the fact that the same equipment has to be used course after course, so inevitably gets worn; or they complain not of the tools on the course but that similar tools, which are those specified for the job, are not obtainable at the place of work. As to the physical conditions in the training school, only minor complaints or suggestions for improvement were offered.

Lighting, eyestrain and mental strain. When we come to this heading, however, we find fifty-seven comments, nearly all adverse. In a good many cases eyestrain and general mental strain were mentioned together. "It has been quite a strain on my eyes and nerves." Quite a number of practical suggestions for improving the lighting were also made. It appears unlikely, however, that the lighting arrangements are altogether to blame; a good deal of care has been given to them. The fact is that these men were unaccustomed to long spells of fine work; they were used to moving about on maintenance work, doing first one job then another, and found it trying to remain seated all day practising adjustments at the bench. This point of view is clearly shown by the comments under the next heading.

Length of course, monotony and boredom. Opinion was almost unanimous that the course was not too short. "The length of the course is just about right." "The course gave me sufficient time to learn." Some of the comments however suggested that the time allowed was too great: "The course is about two days too long." "Two weeks is definitely enough for this course, but even at the end of the first week one is inclined to be fed up with it." The tempo of work required has been discussed in the earlier article. The fact that the work is of one type, *viz.,* carrying out relay adjustments, for practically the whole fortnight gives rise to comments on monotony: "This course is boring as most people coming on the course are used to variation."

Course programme and selection of students. The comments under this head follow naturally from those on monotony, for nearly all the 'programme' points recommend ways of breaking up the course by interpolating lectures, film demonstrations, etc.: "Demonstrations and practical can be split more; in this way the monotony of the course as a whole will be much better." "Very little is done to stimulate or arouse interest regarding use of visual aids."

The seven references to 'selection of students' cover similar ground to that discussed earlier under 'courses in general.' "I am not really interested in this course, the reason being that it plays a very small part in my normal duties. . . ."

Instructors and instructional methods. One example represents majority opinion about instructors: "The instructors were most helpful; nothing was too much trouble." There were however one or two allegations of undue severity in marking completed adjustments. Comments relating to 'instructional methods' cover much the same ground as that discussed under 'course programme.'

Students' motivation. This is the last heading under which we shall discuss comments made, for those that remain are but general expressions of approval that a course was provided on this subject. This category covers a wide range. First there are remarks on the desirability of providing some reward to act as an incentive, such as: "If there was an incentive of a monetary nature in direct proportion to the result obtained, I think men would press to go on courses, try harder to obtain credits or above, and ultimately the standard of work and output would rise." In the next group appears the word 'confidence': "It has given me confidence to do the things when I return to my place of employment." Others comment on the course's relevance to the students' jobs, adding that the knowledge gained should make work easier: "I shall find it much easier now, and I shall know what is behind the adjustments and the correct method of adjusting." A final group refers to the personal satisfaction to be gained from doing well: "I had the satisfaction that I had done well and the effort had not been wasted." "I liked the course because of the personal satisfaction I derived from it."

RESULTS: SECOND STAGE

SELECTED STATEMENTS

The second stage of the survey was to pick out from the comments submitted by each course the apparently controversial or isolated but significant ones, on which the opinions of the whole of the group would then be obtained. To select comments in the time available proved more difficult than had been foreseen, but as each course in fact made similar remarks, on broadly the same topics, the statements put to students were kept constant for the last four of the six courses. These statements, slightly modified from those used on the first two courses, were read out one at a time, and for each proposition students were asked to mark on forms provided either Strongly Agree, Agree, Uncertain, Disagree or Strongly Disagree.

The nineteen statements are shown below, and we shall discuss them in three categories: A, those with which a substantial majority of the sixty-one men agreed; B, those with which a substantial majority disagreed; and C, those where opinion seemed fairly evenly divided. Strongly Agree and Agree responses are combined as are Disagree and Strongly Disagree. Uncertain is ignored except in discussing the third category.

		AGREE	DISAGREE
	A: MAJORITY AGREES		
A1	The amount of time allotted to demonstrations was about right.	40	17
A2	There's a good deal of monotony on this course.	48	10

	A: MAJORITY AGREES	AGREE	DISAGREE
A3	The general conditions of work on this course (lighting, benches, etc.) are quite satisfactory.	45	16
A4	It makes you feel good if you do well on a course, even if there's no obvious advantage.	57	2
A5	If I had the opportunity, I should try to come on future courses.	42	13
A6	The official method of marking is as good as can reasonably be expected.	49	7
A7	Students receive as much personal attention from the instructors as they can hope for.	54	4

	B: MAJORITY DISAGREES	AGREE	DISAGREE
B1	The time allowed for this course (ten working days) is rather too long.	7	54
B2	There's no particular satisfaction to be gained from coming on courses.	4	55
B3	In courses you tend to get a lot of useless knowledge which you may as well forget.	12	43
B4	The main value of courses is that they act as a break from routine.	13	42
B5	Admitting skill at the task to be necessary, it is better gained by experience on the job than by coming on courses.	7	51

	C: DIVIDED OPINION	AGREE	UNCERTAIN	DISAGREE
C1	There is no immediate benefit (e.g., pay, promotion) from passing a course so they can't expect you to work very hard.	24	4	33
C2	Some re-arrangement of the course time-table or programme would be an advantage.	24	16	21
C3	In courses they teach you a lot of stuff which is of little practical use on the job.	21	7	33
C4	It would be better if demonstrations were given immediately before practice on each type of relay.	39	2	20
C5	Care is not always taken to see that the courses you go on are really suitable for you.	31	10	20
C6	The fact that you've attended a course adds to your prestige, or the respect in which you're held, when you return to work.	25	13	23
C7	The methods of work taught and practised on this course are those that are ordinarily used on the job.	31	13	16

It is by no means claimed that these statements are the best that could have been devised, and doubtless some of them might have been better phrased. Nevertheless they served their purpose of indicating how much unanimity of view existed on certain topics which had been spontaneously mentioned. Some discussion of the results follows.

DISCUSSION OF RESPONSE TO SELECTED STATEMENTS

Although there was majority agreement on statement A2, there was strong disagreement that the length of the course should be reduced (statement B1). This seems to indicate that the majority was prepared to accept some monotony as inevitable in a course on this topic, although from statements C2 and C4 it appears as though a number of students felt that some change in the programme would be desirable. Only about a third of the total disagreed with statement C2 and a distinct majority was in favour of the change suggested in statement C4, which might be expected to help in reducing the monotony. The response to statement A1 indicates that in the view of the majority the time spent on demonstrations as opposed to practical work was about right. Taking these opinions together with the general approval of courses that was evident, it seems reasonable to suggest that it would be worthwhile making some changes in programme, and that by breaking up long periods of practical work, monotony might be allayed.

Statements B3 and C3 seem to reveal some difference in emphasis. In the former a big majority disagree that what is taught to them is irrelevant to their jobs, but in the latter only about half are prepared to disagree on the same point. Two other statements have a bearing on this: numbers B5 and C7. Statement B5 affirms the students' belief in the value of training courses, but the replies to statement C7 show that only about half of them considered the methods taught on the course to be those normally used on the job. This is an important point for the course organisers to note.

Statement A6 confirms that complaints about marking come from a minority, while statement A7 supports the impression that relations between students and instructors were good. Statement C5 on the other hand shows that about half the men were uneasy about the way students were selected for courses, and confirms the impression given by the spontaneous comments on this topic. This appears to be another point which merits attention.

From the responses to statement C6, it seems unlikely that students expect to gain kudos from attending a course. This is not surprising, for training courses have a long history in this organisation and every workman must have attended at least one during his service. No rarity value therefore attaches to a man who attends a course. The response to statement C1 tends to support the general impression gained from the spontaneous comments that a number of men would have liked to see a closer relation between success on courses and promotion or special proficiency pay. This was not, however, a majority view.

We are left with a number of statements which give an encouraging view of students' attitudes. The majority said they would like to come on future courses, and found it pleasant to do well though there might be no obvious advantages; they considered there is personal satisfaction to be gained on courses, and disagreed that the break from routine constitutes a course's main value. These statements were aimed at discovering motivating factors in the training situation and it seems as though, in the judgment of these students, personal satisfaction is such a factor.

A SUPPLEMENTARY NOTE

A further study intended to replicate the one just reported was undertaken with a different series of courses in the same organisation, but had to be dropped when after only two courses the series was unexpectedly discontinued. Spontaneous comments were invited in the same way as before; the eighty-nine comments received from twenty students contained a number of suggestions relating to details of administration, but nothing of general interest to add to what has been reported above.

A third and new step was then taken. Each student was given a form containing two questions on motivation and, for each question, several answers selected or adapted from those received in the earlier study; he was asked to put a mark opposite each answer, to say whether he agreed with it, strongly or only moderately, whether he was doubtful about it, or whether it would not apply in his case. This form, with a summary of students' responses, is shown below. (Three students failed to give a response to some of the statements.)

OPINION QUESTIONNAIRE FOR TRAINEES

What do you think made you trouble to try and learn on this course? (Put a mark opposite each statement in the column that best describes your opinion)	AGREE STRONGLY	AGREE MODERATELY	DOUBTFUL	DOESN'T APPLY TO ME
D1 The course gives you confidence to do the real job	12	7	—	—
D2 Passing courses means you get better pay	1	3	8	6
D3 Friendly competition between students and workmates: you have to keep your own end up	3	10	2	4
D4 Course may lead to job advancement: it may help me to get a more responsible position	2	7	9	1
D5 It makes a change from normal routine	5	8	1	3
D6 You have to try and pass even if you're not interested, for you don't want to go back saying you've failed	2	9	1	6
D7 Learning to do a job properly makes it interesting	17	3	—	—

Would any of the following reasons be likely to make you try hard to qualify on any *future* course? Which ones?	VERY LIKELY	QUITE LIKELY	DOUBTFUL	WOULDN'T APPLY
E1 Aiming at a prize given to the best student	2	5	6	7
E2 Prospect of a more interesting, varied or responsible job, *even if it did not pay more*	8	6	3	2
E3 Picking up knowledge that might be useful some time	12	8	—	—
E4 Feeling the instructor is doing his best and that you don't want to let him down	6	8	2	3
E5 Certainty of getting a better paid job	10	4	4	1
E6 Not wanting to show up badly compared to workmates or fellow students	6	6	2	5
E7 Single cash award for reaching a certain level of competence	7	2	5	5
E8 Getting a job with better hours or holidays, *even if pay remained the same*	6	3	7	3
E9 Being known as an authority on the subject	5	7	3	3

All the students replying indicated that the course gave confidence to do the real job, and that learning to do the job properly made it more interesting, seventeen out of twenty agreeing strongly with the latter statement. Less than half thought they had in fact been motivated by the prospect of advancement (statement D4) but three-quarters thought they would be likely to try in the future if they were certain of getting a better paid job (E5). It may be worth noting that three-quarters of the students thought they would expend effort to avoid disappointing the instructor (E4), and that greater emphasis was placed on interest and prestige (E2, E6 and E9) than on cash prizes or improved hours and holidays (E1, E7 and E8); while the only reason chosen by all students as a probable cause of future effort was 'picking up knowledge that might be useful some time' (E3).

GENERAL DISCUSSION

We must now try to assess how far the information obtained from these studies helps to answer the questions asked at the outset: broadly, what were the motivating factors in this learning situation? It is important to remember that we were dealing with a special situation, unlike other industrial training in ways which were detailed in the previous paper; we must not be tempted to suppose the present findings typical of industry in general. Bearing this in mind, two points seem worth noting.

Firstly, the striking thing about the spontaneous comments is the extent to which the organisation not of the training school but of the whole undertaking was mentioned. From the students' point of view, it seems that the training school is merely a small part of a larger organisation, and their attitudes towards that part reflect their attitudes and opinions towards the whole. It is the organisation as a whole which controls them; though they may have views on training, and this study shows that they have, these views are part of a framework of attitudes about the organisation in which both they and the training staff work.

The second point relates more directly to the aim of this inquiry. The opinions expressed emphasise the personal satisfaction that may be gained from attending a course and doing well on it, even although no obvious advantage can be seen. This is shown not only by the second stage of the main study, but also by the smaller study, which used the same set of statements. It is true that the nature of the employment would minimise the likelihood of immediate gain (*e.g.,* increased pay, or promotion) from success on a course; in consequence the purely personal satisfaction may possibly receive more emphasis. Nevertheless it seems of interest that so many men were prepared to agree that the prospect of personal satisfaction might be a source of motivation.

We may perhaps attempt to evaluate the method used in this study to obtain students' views. It proved worthwhile to invite students to comment on those aspects of the situation which were of importance to them: if questions had been asked, as a first stage, it seems likely that quite other points might have been emphasised, reflecting the preconceptions of the investigators rather than the attitudes of the students. On the other hand the collection of free comment by itself does not go far enough; the difficulties of analysis are considerable, nor is it easy to gauge to what extent the sum of the comments made by individuals represents the views of the total group. An effort was made to deal with this latter point in stage two of the procedure. However, some such device as the opinion questionnaire tried out as stage three in the smaller study may be more useful. It is possible that the results of the main inquiry would have been more valuable if such a questionnaire had been used at an earlier stage.

SUMMARY

A description has been given of the method and results of an attempt to obtain information about motivational factors at work in a learning situation.

A brief discussion of the results has been presented, and it has been concluded that the collection of free comment probably needs to be followed by the administration of questionnaires or other similar forms based on the original comments, if information of value as well as interest is to be obtained.

REFERENCE

WILLIAMS, D. C. S. (1956): Effects of Competition between Groups in a Training Situation. *Occupational Psychology,* 30, 85-93.

APPENDIX A.

OPINION SURVEY, STAGE I.

In order that the conditions may be as similar as possible for different courses, or for different investigators, the following "patter" has been drafted. An investigator should follow the wording given, if not word for word at least very closely.

After the class has settled down, the investigator, standing in front, says:

"First of all just let me explain who I am and where I come from. I work for the National Institute of Industrial Psychology, and my job at present is to make a study of training courses, not only here but anywhere else they are held, in factories, offices, etc. The .... have very kindly allowed me to come here and see you, but I have myself no connexion with the ....; the study I am making is a completely independent one and is not being done on behalf of the .... I am saying this because in a moment I shall ask you for your opinions about training courses, and I want to make it clear that any opinions you are kind enough to express to me will be regarded as entirely confidential. Anything you say will certainly not be passed on to the ...., except perhaps in very general terms, but certainly not so that anyone can know who said what.

"Now let me explain what I want you to do. I want you to give me any opinions that you may have about training courses in general, and also any ideas or comments about this course which has nearly finished (I realise this isn't a very easy thing to do). Probably all of you have from time to time said things like this: 'Courses are all very well but...........' or 'the trouble with going on courses is...........' or 'I should feel happier about going on that course if...........' Do you get the idea? I want you to give any comments or opinions you have about courses, not necessarily criticisms, points in their favour as well if any occur to you.

"Then about *this* course; how have you felt about it? What about the length of the course, the kind of instruction, the usefulness of the course? Will it do you any good? Would you like the chance to come on others like it? Are there some points about it you liked and some you disliked?

"Now I'm going to give out some pieces of paper, for you to write down any comments you have.

"Remember, I'm asking for comments about training courses generally, and also about this course. Just to help a bit, I'll put two or three examples on the blackboard."

Courses Generally	*This Course*
"It's a good idea to go on courses because ...."	"It would be better if..........."
"Courses are often a waste of time because..........."	"I liked it because..........."

Interrelation of Attitudes and Communications in a Sub-Divided Working Group

By R. A. M. GREGSON

Mr Gregson was until recently a Scientific Officer in the Department of Scientific and Industrial Research, Intelligence Division, and is now a Psychologist on the staff of J. Lyons and Company, Limited. This paper was read at the 1956 Meeting of the British Association for the Advancement of Science.

DURING the last century large transport systems have developed in many countries. Thousands of persons and many thousands of tons of freight are moved from point to point by land, sea, air, on regular scheduled services. It is possible to go to any railway terminal, coach station, airport or dock and be reasonably certain that some sort of vehicle will be arriving or departing at about an advertised time. We take this so much for granted that we are surprised or annoyed when we are late.

All these transport systems need integrating; that is, besides being planned in advance so that one service connects with another, the various parts of the organisations have to be brought together, usually at some central point. For example, if anyone wanted to run a bus service, with perhaps hundreds of buses, he would find it very convenient, if not imperative, to establish a place where the movement of crews, buses, petrol or fuel supplies, repair services, public relations and so on, were co-ordinated. Everything should be in the right place at the right time. If there are breakdowns then the replacements must be at hand, and there may be a need to provide special services for special people, such as pilgrims, tourists or V.I.Ps.

Leaving aside classical antiquity, all this was first realised, in recent times, in railway operation. Central control rooms were established which grew in complexity and in the amount of equipment they used. Today there are central control rooms in railways, in shipping companies, in airlines, for police patrol cars, and of course in many military applications. The general staff headquarters can be regarded as a special case.

I was recently privileged to observe such a control room, and I would like to describe it, not for the work it does—though of course that is important —but for the effect that the organisation of its work had on the men in it, and the converse effect that their attitudes had on the organisation of the work. I am not going to say what sort of transport was involved, for reasons of confidence, so I will call the passenger and freight transporters involved 'transport units'. They could have been anything; it is sufficient to say they have a man in charge, a load, a route, and a timetable.

Part of the business of a transport control room is to move information, to move it between different sorts of specialists and up and down the lines of authority within the organisation. The control room can also give information to people outside the organisation, or take it from them. The other part of its business is to make decisions, and once decisions are made by one person they constitute information for another. In this way decision-making can be regarded as an operation performed on information in motion. For generality, we can say that *not* passing on information is a type of decision.

In the control room the staff fell into two sub-groups, hence the title of this paper. These groups had different but rather similar jobs, and were parts of different lines of authority within the same transport organisation.

The first group were Services Controllers, and part of a major section of the organisation whose job was to plan and maintain advertised services by co-ordinating the activities of the engineers, crews, public relations departments, and so on. The control room was legally theirs; by 'legally' is meant that it was part of the formal organisation and structure of which they were members. Accordingly the detailed facilities used within the room, by all the staff permanently there, were largely their responsibility. Telephones, loudspeaker intercommunication, and the services of clerical messengers were under their control, with an exception which I will come to later.

It is necessary to maintain a twenty-four-hour watch in a control room, so here there was always a Duty Controller, with two deputies, present. During the day there were also four clerks or assistants, taking and transmitting messages, but a demarcation must be made between the clerks who had no decision-taking authority and the controllers who had. At night only three clerks were present. Two of the clerks operated a switchboard communicating with other departments; the others were messengers, who kept up to date a display board which ran the length of one side of the room.

The second group were Technical Controllers. They regarded themselves more as engineers by tradition than their Services colleagues were, though in fact their engineering knowledge was useful mainly in interpreting reports of breakdowns to estimate the extent of future delays. They possessed a switchboard of their own, connecting with engineers in the nearest repair workshops. but most of their information came in through the communication network established and operated by the Services Controllers. For illustration, the relative sizes of the switchboards operated by the Services Controllers' clerks, and by the Technical Controllers, were 27 channels and 4 channels, though not all channels were equally loaded. This Technical group was made up of four men on duty: a Duty Controller, assisted by one deputy and two clerks, whose work was mainly planning the allocation of transport units to services, and to compensate for breakdowns and ensure that a maintenance schedule was followed to get the most use out of a unit.

The control room thus served as a liaison point, where decisions which involved two lines of authority could be reached by face-to-face consultation between representatives of the two lines. The general types of information, such as arrival or departure times, or payloads, were fed into the room by telephone or printed messages and were mostly the concern of the Services Controllers, who saw or heard these messages first. But there were some messages, which I mentioned previously, which were the prime concern of the Technical Controllers because they consisted mainly of engineering information. Such messages, if from engineers working close to the control room, came directly to the Technical Controllers, but other engineering information, from engineers geographically more remote, could come in as part of messages sent to the Services Controllers, and then get to the Technical Controllers by devious routes within the control room.

Without going into the detailed contents of these messages, or the manner in which they may be classified according to source or content or the implied action to be taken upon receipt, we may sum up the situation by saying that the Technical Controllers were in a state of partial dependence on the Services Controllers for their information input.

The classification of messages on arrival, though in theory the subject of joint agreement by the two control groups, was delegated to clerks subordinate to the Services Controllers. This arrangement was the cause of some disagreement, centring on the classification of messages according to the priority of destinations within the room, and on the actual method of distribution.

Whilst in theory the Services Controllers had the last word—that is, in the formal structure of authority they were senior—it was commonly the practice to reach compromise solutions with the Technical Controllers. For example, if a transport unit broke down the decision to run the service with another unit, whilst partly determined by the passengers' requirements and general company policy, depended also on whether the Technical Controllers had available another unit with the same or similar capacity.

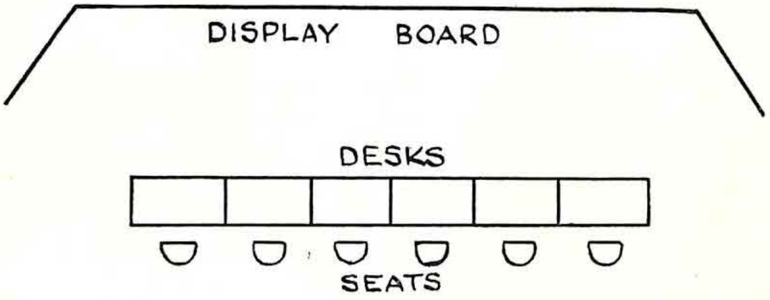

FIGURE I. PLAN OF A CONTROL ROOM

Figure 1 shows a plan of the control room. The display board was the most striking single feature, for it ran the whole length of the room, parallel to the row of desks behind which the controllers sat so that they faced the board. The board carried information about current services for all the Controllers, Technical and Services, to refer to. However, there was considerable variation in the extent to which individuals relied on the display board as a source of information. Some preferred to get their information by other, apparently more indirect, ways and this difference in the extent people relied on the board is fundamental to the Analysis I will present later.

Because the board was looked after by clerks supervised by the Services Controllers, the information on the board was only put there on the orders of the Services Controllers. Most of these orders were embodied in a routine procedure, which was supplemented by spoken instructions if a Duty Controller so wished. In this way the board provided an information link between the different controllers, for what the Duty Services Controller instructed the Clerks to display was immediately available to his colleagues. But other controllers could not use the board in the same way, so information only passed *from* the Duty Controller and not *to* him by this link.

Unfortunately, due to the growth of the control room's work, the display board has become too small for its job, and also a focus for disagreement amongst the staff.

In studying this type of situation, where a compact and highly integrated group works together, in our case with one critical internal division, there are different ways of getting a record, or a picture, of what is happening. And these ways, which are in a sense measuring instruments, give different answers. The first method used was direct observation. In this way, an estimate of the nature of each job in the room was made; the information flow to and from a job was measured by a count of messages according to content; and the general physical features of the working environment were noted. These features included the visibility of information displayed on the board, the distance apart of colleagues who frequently communicated, the provision of equipment such as telephones, and so on. It is not suggested that direct observation is more objective, in some special sense, than any other method of study, but the assumption is made that if such observations are made throughout by one investigator any bias or errors of judgment will affect all the observations in a similar fashion. For instance distances may all be slightly over-estimated, but comparisons of distances are still permissible.

A second method of recording a job, also used, is to interview the people doing it, in the workplace, in front of their colleagues. This of course gives a mixture of facts, opinions about the job, emotional attitudes to the working situation as a whole, and suggestions for improvements. The latter are usually better than anything the investigator himself can produce if they are taken with caution and weighed against each other, to see if they are perhaps contradictory.

A third method is to circulate a questionnaire. This was done last, partly to get comments from the few controllers who had not been interviewed in their workplaces, because of the shift system; partly to get data on specific points which it was felt from observation and interviews were contentious, and about which men preferred to comment in anonymous privacy. The questions were divided into those directly bearing on the use of the display board, and those on general working routine, plus two completely open questions to permit the inclusion of material which individuals felt was important. Over sixty per cent of the staff, who numbered over seventy in all, replied to the questionnaire.

It was possible, therefore, to compare the investigator's observations in methods two and three. Such a comparison should reveal if the replies of any particular group were differing in a systematic way from those of another group, or from what the investigator expected on the basis of his own observations. Such differences, if interpreted as indications of the way individuals see their work, can give an indication of their attitudes towards various features in their environment.

For example in method one the investigator estimated the percentage of the board's area clearly visible from each workplace. In method three, the questionnaire, each respondent was asked to estimate what parts of the board he could see clearly from his desk. For each job, because of the shift system, there were a number of men. The averages of their estimates were taken, and divided by the investigator's estimate. This gives a ratio of the mean area of board claimed visible by controllers and the area estimated visible by the investigator; if the controllers agree with the observer the ratio will equal one. If, however, they disagree and reject the board as a source of information the value will be less than one, and a value of zero would imply a complete rejection of the board. The figures obtained were, for the Technical Controllers 0.27, for their Assistants 0.32, for the Deputy Services Controllers 0.50 and for the Services Controllers 0.82. The order in which I have quoted them corresponds to an increasing degree of acceptance of the display board, and this picture corresponds closely with the opinion of the staff expressed in interviews.

Lest it be thought that the range in attitudes had biassed all the subjective estimates of working conditions, I may cite as an example that the staff were asked in the questionnaire to estimate the amount of walking about they had to do in their work. This was compared with observations of mobility in terms of distance walked, contacts initiated and received. Here the measures showed reasonable agreement.

It was the questions about the use of the display board which showed the most variation between groups; and two types of response were evoked. In one question the thirteen types of information displayed on the board were listed, and the respondent was asked to indicate which he used in his work, and which he considered important. Although this dual classification produced some replies which were bizarre, the items were ranked by the investigator according to the number of people using them. This gives two rank orders, and the correlation between them was +0.92, which suggests that, generally, items used were considered important. Some people either accepted everything or rejected everything, with a fierce comment to that effect. But this extreme type of response, which was in fact the stereotyped opinion of the group to which the respondent belonged, was more in evidence in open interview than in the confidence of the questionnaire. It appears that in the presence of the group a man gives the opinions of the group, whilst in isolation he is more prepared to be critical in detail.

Observation and questioning revealed that the arrival and departure times of a transport unit were considered the most important items of information, and those on which most decisions hung. There is nothing very surprising in this; but as it was information used by all the staff and displayed on the board in front of them, it is instructive to examine the paths it took within the room.

An advance estimate of an arrival time came in by telephone printed message. It was passed to the clerks maintaining the display board, and they posted it up. If the message contained other information it was brought to the Senior Controller of one of the two sub-groups. Arrival times could also get to an individual controller by other routes. Instead of waiting for one to appear on the board he could ask a colleague who sat nearer to the clerk first getting the arrival times; or he could pass slips of paper bearing information or requesting information. And again, he could get up and walk about to ask other people if they knew. These other ways of getting information had become most-preferred ways for the Technical Controllers, but in the main the Services Controllers used the display board in preference to anything else.

I want now to put this behaviour into a theoretical background, by relating it to more general ideas about preferences and changes in preference. Let us call each of the places from which a man can get information 'an information source', and let us give names to different information sources according to the preferences of the individual using them. I will define an information source used in preference to all others, when equally available, as a 'primary information source'. The next choice will then be 'a secondary information source', and so on. By extension of this idea, a *class* of sources is a collection, the members of which are all equally preferred. In the control room the two groups had a primary source, the display board, and a number of secondary sources; face-to-face conversation, telephoning, passing slips of paper, walking over to a colleague. In the case of the Technical Controllers the primary source was rejected, and some of the secondaries collectively promoted to a new primary class; by this I mean that within the new class each method of communication was regarded as about equally useful and to be preferred to the original primary, the display board. We can say a collective indifference existed within the new primary class, and a collective preference existed between the primaries and the secondary. An analogy may help here; if a man likes all sorts of tea equally, and prefers tea to coffee, the teas are a primary class and coffee is a secondary, and he may be said to have a collective indifference within the class of teas.

The attitude of the Technical Controllers to the display board was a subject of criticism by the Services Controllers who considered, when interviewed, that their colleagues were rejecting a useful instrument. The opinions of the two groups were less clearly demarcated in the questionnaire, where new opinions, such as 'the display board is a bit of window-dressing for visitors' appeared in both groups.

By contrast with the Technical Controllers, the Services Controllers, being responsible for the display board, and using more of the information on it than did any other group, kept it as their primary source, with the aid of secondary sources. But in the event of a major traffic dislocation the system broke down; the primary source became a secondary source, with slips of paper appearing as a new but rather 'rocky' primary.

I suggest that what an observer can see in an industrial situation is a slice out of a long process extending through time. Here we have two groups of people, in very similar situations, who have developed different systems of priorities in using a range of information sources open to them both. From the interviews conducted it emerged that at one time the Technical Controllers used the display board to the same extent as did the Services Controllers, but have moved away from that position to the one held when the observations were made. But this is a description of behaviour during a routine day's work. Under stress, when, say, there was a fog or floods, the work of the controllers became more intensive and difficult. And then the Services Controllers were forced by the logic of the situation to change their procedure to something approaching that used by the Technical Controllers.

The working pattern adopted can be thought of as having a position in a two-dimensional space. One dimension is time, with which the pattern constantly changes, perhaps only slightly, and the other dimension is stress, in which there can be abrupt changes in either direction. Figure 2 is intended to represent this:

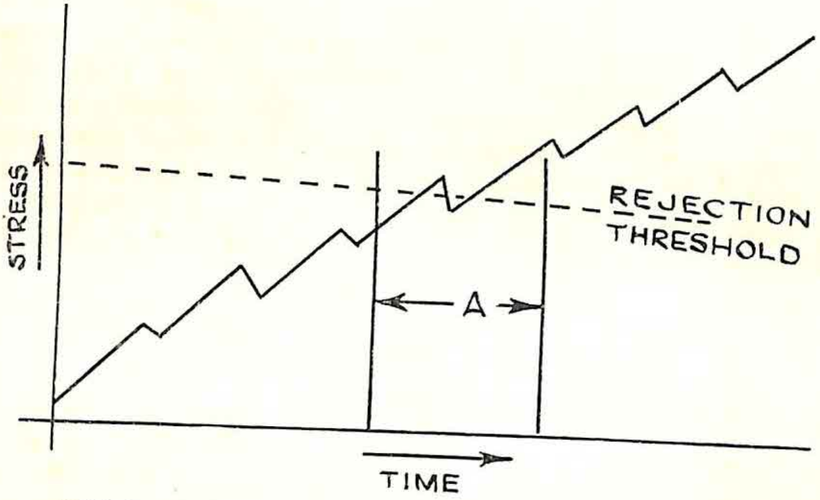

FIGURE 2: STRESS, TIME AND THE REJECTION THRESHOLD

The rejection threshold marked is a level of stress at which the group rejects the primary information source in favour of the secondaries, as mentioned previously. This threshold had already been passed by the Technical Controllers, but the Services Controllers were still in the range A where the pattern of working with information sources depended on the stress of the situation. Thus it appears that the Technical Controllers have moved further to the right of Figure 2 than the Services Controllers.

The questions then arise, why did these two groups stand at different points in the process of developing new working methods, and could the Services Controllers ever 'catch up' with the Technical Controllers? The answer to the second question is one that can only be given by further observation, but I would like to outline a theory from which predictions might be made.

If the original formal working method, with the display board as primary source in our case, is to be modified, it can be done in stages.

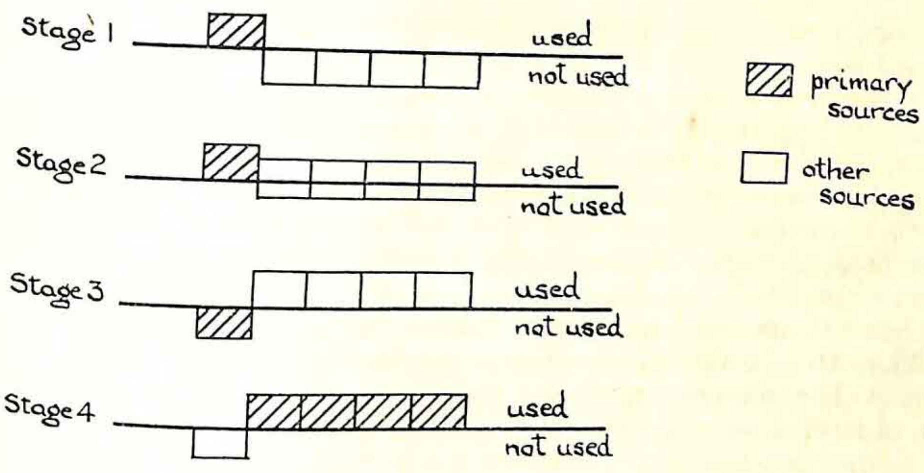

FIGURE 3: MODIFICATION OF THE WORKING METHOD

In Figure 3, the prescribed set-up is the first stage; that in which secondaries appear and occasionally supplement the primary is a second stage; and that in which the primary is temporarily replaced by secondaries is a third stage. The fourth stage is where the original primary is rejected for a new primary class, and this is the stage at which the Technical Controllers had arrived. The next stage would be the emergence of a new single primary from amongst the class as in Figure 4:

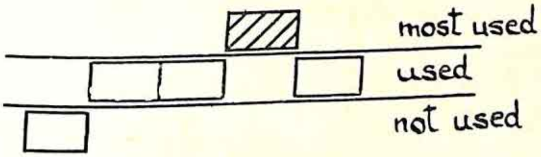

FIGURE 4: A NEW PRIMARY

and the whole cycle could then repeat itself. For this sort of progressive change in working methods to appear at all, the original set-up provided by management must in some way be unsatisfactory to the users.

Once a group has started on this path of long-term change, and I think the evidence of behaviour under stress suggests that the Services Controllers had, then the rate at which they progress, and whether any external factors can arrest change at some stage, is dependent on the role the management play in insisting on the use of the primary source apart from its utility. The choice is whether or not they regard it as part of their responsibility, that is, the property of their group. Obviously here, the Services Controllers in general were encouraged to feel this way, the Technical Controllers were not.

This control room is perhaps a special case of situations which can be found where almost any large group works together and there is scope for developing different ways of working within the framework of the procedures laid down by authority. A striking thing is the degree to which the individual's perception of the working situation, and his evaluation of salient features within that situation, are determined in a large measure not by any objective assessment he makes of his work, but by his identification of those salient features with persons or groups concerned with the administration of the organisation. Communications are particularly vulnerable to the creation of informal procedures, to the creation of 'bypass channels', and the very existence of informal procedures can serve as a signal to the investigator to look for discontent originating in something perhaps quite unrelated to communications themselves.

The work upon which this paper is based was undertaken by the Industrial Operations Unit of the Department of Scientific and Industrial Research. I should like to express my thanks to the transport organisation concerned for permission to use material upon which this paper is based, and to the men, some of whose work I have described, and without whose willing co-operation nothing would have been possible; to D.S.I.R. for giving permission for publication; and to Mr R. G. Stansfield for his valuable constructive criticisms during the preparation of this paper.

Training in Perceptual Skills

By MARY D. ALLAN

This paper was presented to Section J of the British Association at its Sheffield Meeting in August, 1956. Miss Allan is a Senior Psychologist on the staff of Air Ministry, Science 4.

ALTHOUGH there has been much psychological study of perception, and some recent controversy about its nature and the effect of experience upon perception, very little is known about how to teach perceptual skills. The fact that people have been acquiring perceptual skills and skills of recognition since infancy does not really help much, because none of these common skills involve formal training. Young children, for instance, learn to recognise and name faces and objects without any formal training at all. They then develop the power of perceptual generalisation which, if it were not so universal, would rank as a great accomplishment. For example, having acquired the ability to recognise an object (a table) the child is able to identify it again in spite of quite major changes in size, shape, colour, position. The really startling nature of this accomplishment is only apparent when we try to give comparable formal instruction in shape recognition such as aircraft recognition, tank recognition or ship recognition. It was the war in fact which forced upon us the necessity of giving formal training in these skills, and the people who were already expert simply did not know what mental processes had been involved in acquiring their skill. Psychological theory at that time gave very little help. Judging by the difficulties experienced by many trainees, they still have not found the secret of teaching these skills effectively. This is not an unfair observation when we consider that, intrinsically, it can be no more complicated an operation to learn to recognise aeroplanes than it is to recognise faces.

Any applied technique of training in perceptual skills must subscribe to some basic theory regarding the nature of perception. At the moment that is a somewhat controversial subject, so I propose to start at the other end, to try to devise a technique which works and which bears some resemblance to childhood learning. This can then be analysed and related to a theory of perception. With this end in view, I shall describe two field studies which I have carried out for the Royal Air Force in which there is evidence of the smoothness and spontaneity which characterise the learning of children in their self-chosen skills. The studies were concerned with teaching aircraft recognition and the Morse code.

Aircraft recognition is one of those subjects in which pupils tend to fall into two categories: the enthusiasts who already can identify a good many types of aircraft before they start formal training; and those who have never had the slightest interest in distinguishing one aeroplane from another. The latter invariably find the subject difficult.

The conventional method of teaching aircraft recognition involves the three-view silhouette. Visual characteristics are pointed out and pupils are required to commit to memory technical details such as swept-back wings, dihedral tail-plane, and projecting engine nacelles. To the non-enthusiastic novice it is all very bewildering, and instructors have been encouraged to sugar-coat the bitter pill with what they call 'a bit of glamour', that is, with interesting information about the aircraft and its history which may have little to do with spotting.

I was originally drawn into this study because I was asked to assess and put to the test of experiment certain training devices which were being produced by Charles Sargeant, the editor of the *Joint Services Recognition Journal*. These devices were based upon some very radical ideas on the subject of recognition training which can be summed up briefly in his assertion that spotting involves only the ability to identify shapes and, as it is concerned solely with visual perception, it is unnecessary to teach it by lectures involving technical information. Theoretically I was in complete agreement with him, on the grounds that the recognition skills of everyday life, such as the ability to recognise people and things, are not acquired by deliberately memorising individual details. We decided that some sort of controlled activity giving visual and naming experience of aircraft should give better results than listening to lectures.

Together we worked on a device which is essentially very simple. Each pupil is given a book with about 120 views of four aircraft similar in design. He is also provided with attractive key photographs of these four aircraft. Without any formal instruction he is invited to go ahead and identify the aircraft in his book by cross reference to the key pictures and to write down the name each time he succeeds in identifying one. The challenge to identify by their own efforts never fails to evoke a response, and the fact that it can be done fairly easily arouses interest and satisfaction. Subconsciously a 'feel' for the aircraft is built up through these many acts of identification. An important feature of the technique is that the name should be written down every time a view is identified.

The group on which this method was tried out experimentally consisted of 62 men under basic training as light anti-aircraft gunners. Gunners were chosen for the experiment because, unlike aircrew, very few of them know anything about aircraft spotting before taking the course which, incidentally, is generally regarded as an exceedingly boring part of their training. The performance of this group was compared with that of a matched sample of 62 men (matched for initial knowledge) who had been trained by the conventional methods under the same conditions by the same instructors. In the final spotting examination on 20 aircraft, the experimental group had significantly better results than the control group ($t = 2.72$; $P = 0.01$). Furthermore, spontaneous interest and enthusiasm were exhibited by the men in the experimental group and, as reported by the Commanding Officer, there was genuine reluctance to leave the class on completion of the training period.

The Morse study originated in an endeavour to devise a method of teaching the Morse code which would greatly reduce the strain and tedium generally experienced during the learning period and yet produce as good results as the standard method then used in the Royal Air Force. This standard method consisted of learning the Morse alphabet first of all from a card. Then the letters were tapped out slowly so that pupils could distinguish clearly the separate long and short sounds which make up a Morse character. This was essentially an analytical technique and the learning process in the early stages depended upon memorising details. No serious complaint could be made about the standard of skill eventually achieved by pupils trained by this method, but there was always a high casualty rate due either to apparent lack of aptitude or to complaints that learning Morse caused headaches.

The method which I am advocating in this paper I have called the 'pattern recognition' technique. It consists of treating each Morse character as an indivisible pattern of sound. Right from the start separate Morse characters (*i.e.*, letters or figures) are transmitted at a speed corresponding to 20 words per minute, which is operational speed. Slowness for beginners is achieved by lengthening the gap between each character, not by slowing down the character itself. There is no preliminary learning of the alphabet from cards, and beginners are discouraged from looking at visual dots and dashes. They must deal only with the sensory experience which comes to them through their ears.

A lesson, prepared by the instructor beforehand, consists of a certain number of repetitions of not more than four new characters. This is fed into the automatic transmitter. Both instructor and pupils listen to these Morse symbols as they come over at a speed corresponding to 20 words per minute with a gap of 7 seconds between each. During the gap the instructor writes on the blackboard the meaning of the symbol and the pupils write it down. All initial learning is done in the class-room and consists simply of listening to sound patterns and associating each with its meaning. At the first impact the Morse is incomprehensible nonsense, but after remarkably few repetitions, during a single lesson, the ear begins to experience individuality in the sounds, and recognisable features in the characters begin to establish themselves. After one lesson most pupils can recognise and name a limited number of characters transmitted individually at operational speed.

The question now is, Do they learn as quickly this way as they do when the characters are analysed and deliberately learned? The answer to this lies in an experiment where 64 men, under training as wireless operators, were trained by the pattern recognition technique and their performance compared, after the same period of training, with that of a matched control group trained in the conventional way. The comparison was made on a test of letter groups covering the whole alphabet transmitted at 6 words a minute, which is hardly a test of speed, but is really a test of knowledge of the alphabet. The experimental group was significantly better than the control group, with a chi-square = 14·73 (P less than .001). This suggests that the best way to learn patterns of sound is to tackle them as wholes rather than by analysis.

The acquisition of speed—that is, the ability to receive a rapid continuous flow of signals—is, of course, the mark of the skilled operator. By that time the recognition of, and response to Morse signals has become automatic, and it can only be achieved by practice. The building up of speed I believe to be a different skill from learning to recognise sound patterns, although to some extent they may develop together. For speed, practice is essential, but so also is a taste of achievement in the early stages of practice. In teaching the Morse code according to the method which I have been describing, I present the letters in the following order:

P W F Y Q L U/B D X R S M J/G Z C K H V/N O A I T E

This, according to an order of difficulty drawn up by Keller and Taubman (1943), gives a definite concentration of difficult symbols at the beginning. The letters are dealt with in blocks of seven and six, and at the end of each set, attempts are made, in a couple of lessons, to achieve a speed of 8 words a minute in the reception of these few characters.

The experience of achieving speed in a few characters early in training is an enormous incentive towards further practice. In this I believe I am in agreement with Douglas Seymour (1954) who recommends that industrial trainees should try to achieve experienced workers' speed on a part of the operation as early as possible in their training rather than try to learn the whole operation and achieve speed later. He points out that, if a trainee has to wait a long time for the sense of success, failure will often intervene.

In my early thinking on this subject of Morse training, I was of the opinion that what I now call the pattern recognition technique was in fact the establishing of a form of conditioned reflex. I reasoned that, since the skill when learned is an automatic response to auditory stimuli, then the best way to achieve this would be to submit to the repetitive drill of writing down the correct letter every time a Morse symbol was heard. If that were true, submission to repetitive drill would be the sole requirement of learning. No mental demand would be made on the pupil, and the continued association of the sound with its meaning would, in itself, be enough to induce the ability to respond automatically to the Morse code. Close observation of pupils under training confirmed my belief in the soundness of associating whole patterns of sound with their meaning, but caused me to change my opinion about what was really happening. Most pupils found it impossible to be mentally passive, and those who were, simply did not learn fast enough. The most successful pupils were acquiring a knowledge of the different sounds by attending to some detail in relation to the whole pattern.

This process can be illustrated by a description of an exercise in visual recognition which Mr Sargeant recently sent up for assessment. It concerned learning to recognise a tank called the Conqueror. I know nothing about tanks, and I had never heard of the Conqueror. What I was given were five different photographs of the tank—side view, back view, front view, top view and slanting view; this constituted the key information. Identical copies of these pictures had been cut up into pieces suggestive of a jig-saw puzzle, enlarged, mounted as photographs and mixed with similar photographs of parts from other tanks. The task was to examine each piece, match it against the key pictures, and decide whether or not it belonged to the Conqueror. Essentially this exercise is equivalent to a tour of inspection of the tank where the observer notes every detail in relation to the whole. When I had finished the exercise I was aware of knowing a shape without being able to describe or draw any of the details. This was proved to be true a few days later when I immediately picked out all the Conquerors from a mixed collection of 40 photographs of tanks all roughly similar in design.

These field studies suggest that the essence of learning a recognition skill lies in paying attention to detail, not in isolation, but in relation to a whole structure. Nothing else is required and an innate involuntary structuring process, which is not intellectual, does the rest.

How does this measure up to present day theories about perception? The atomistic view of the nature of perception, which was held by psychologists in the early part of this century, is responsible for the atomistic methods of giving formal instruction in perceptual skills. These psychologists believed that a given perception could be analysed without loss into elementary units, hence the logical method of teaching a recognition skill was by analysis. In practice this is an intellectual process of studying parts which are later synthesised and memorised by some other intellectual process such as logical association. It is my view that much of the difficulty experienced by adults in acquiring skills in adult life is due to this analytical approach. Whether or not the early psychologists are correct in their view that perception can be exhaustively described by a process of summation, the fact remains that, when it comes to learning perceptual skills, young children have acquired the ordinary skills of perception long before they are capable of appreciating that one and one make two.

But it could be argued, as the Gestalt psychologists do, that basic perceptions are not learned—that there is an innate organization of perception giving an immediate awareness of form, and that no learning precedes the abilitiy to distinguish instantly between such elementary shapes as a circle, a triangle, a square. According to this theory pattern perception is either present at birth or appears later in the normal course of physiological maturation.

This claim of the Gestalt psychologists that perception is independent of learning has been challenged in recent years, notably by D. O. Hebb. In support of his belief that perception is a function of experience, Hebb (1949) quotes clinical records, collected by the German, Senden, of congenitally blind people who had their sight restored by surgical operation. These records show that, although their vision has been restored, the patients are totally incapable of identifying and distinguishing between the simplest of shapes. They have to learn to perceive a triangle as a triangle, a square as a square, a circle as a circle. The learning is laborious and slow arriving, after a period of apparently no progress, to the sudden and automatic perception of the whole figure as a unit; that is, the square is seen instantly as a square, the triangle as a triangle, the circle as a circle. After this initial learning stage patients manifest the generalisations characteristic of normal people. Hebb (1949) writes:

"At first there is a period of delight particularly in colours and apparently a complete preoccupation with the new experience, but before long the patient finds out how hard it is to get an effective use of pattern vision. Until that point there is interest and application but it takes a long apprenticeship before any useful or demonstrable learning occurs in pattern vision. Learning is evidently going on in this period as long as the patient continues to keep his eyes open and makes any effort, but it can hardly be demonstrated except in the later increase of efficiency."

I draw attention in this quotation to the implication that there is a longish period of apparently no progress followed by the sudden acquisition of an ascertainable level of skill. Progress goes on apparently without the learner being aware of it or outside observers noticing it until the sense experience suddenly integrates into the ability to recognise a shape at a glance. If Hebb is correct in this belief, that the ability to see simple shapes as distinctive wholes is the result of complex learning, then the matter is of the utmost importance to the teaching of perceptual skills. It suggests to the practical teacher that the mind may have a capacity for structuring sense experience which functions in a way not available to introspection but which, if correctly exploited, will facilitate the learning of new skills.

So far as training in recognition is concerned, I have argued in this paper that the atomistic approach (which is the usual one) is not the most effective, and I have demonstrated that a form of Gestalt approach is more rewarding. However, it has been the more recent investigators, with their insistence that perception is a function of experience, who have inspired me in my efforts to find more efficient ways of teaching skills. They do not deny the Gestalt nature of perceptions, but they insist that a learning process precedes the most elementary perception of form. If they are right, then it is a challenge to the teacher of perceptual skills to study the circumstances in which the perceptions of everyday life were acquired, and to reproduce these conditions as far as possible in situations where formal training is given in comparable skills. That in fact has been my endeavour in these field studies, and I have come to the conclusion that the learning of a recognition skill is an automatic process provided that attention is repeatedly directed to detail in relation to the whole perceptual pattern. This suggests the existence of an involuntary structuring capacity possessed by the brain, and it gives a twist to the Gestalt doctrine of 'innate organization of perception' by suggesting that, instead of an innate ability to perceive form, there exists the much more flexible concept of an innate capacity for perceptual organization.

SUMMARY

Although people have been acquiring skills since infancy, little is known about how to give formal training in skills. This paper is an attempt to link up some of the more recent views about the nature of perception with the learning of recognition skills, and to isolate some of the factors which appear to determine success.

The views expressed in this paper are in opposition to the atomistic treatment or learning of parts which is still the familiar method of teaching recognition skills, and which has its basis in the beliefs regarding the nature of perception held by psychologists in the early part of this century. Instead, a modified Gestalt approach is recommended, based on the views of D. O. Hebb and others, that perception is a function of experience and therefore is a learned process. This involves a departure from the Gestalt doctrine of 'innate organization of perception' with its denial of the effect of previous experience upon perception, and postulates in its place the more flexible concept of an innate capacity for perceptual organization.

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Simplifying the Controller's Task Through Display Quickening

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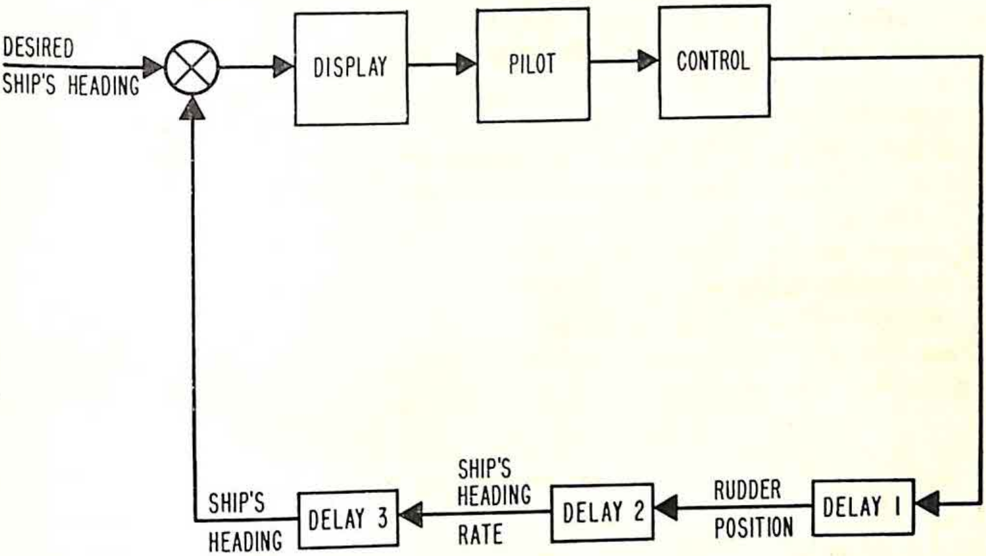
IT is axiomatic that in order to learn anything one must have knowledge of results. It is also true that many of the basic postural and manipulative motions are controlled through 'feedback', which is another form of knowledge of results. Norbert Wiener (1949) and other cyberneticists have emphasized the fact that we monitor and direct many of our movements in space through a continuous flow of visual and kinesthetic signals which provide us with information as to how well we are accomplishing our purpose. In picking up a pencil, for example, our proprioceptive and visual receptors continuously furnish us with a knowledge of where our hand is, so that we may relate it to where it should be, and thereby allow us to correct and redirect our movements in accordance with the location of the pencil. When this feedback is interrupted, as by closing the eyes or cutting the sensory nerves leading from the receptors in the muscles, tendons, and joints, these movements are disrupted and become chaotic.

In simple eye-hand coordination tasks such as those which are most usually encountered in our daily lives, the fed-back information provided directly by our senses is adequate to produce highly coordinated movements. However, when it is necessary to take action upon the world through some machine which acts as an intermediary between ourselves and the physical environment, difficulties are sometimes encountered. These difficulties arise from transformations, or time lags which are introduced by the mechanism into our controlling functions. Thus, in piloting ships, flying aircraft, or diving submarines the motions of the vehicle lag behind the responses of the operator by a considerable amount and this, in turn, increases the difficulty of the controller's task to a point where he is sometimes almost unable to control at all. To the operator, it is as if his senses had been slowed down to a point where he knew what he had done only a long time after he had done it. Obviously, such a state of affairs is undesirable if control precision is desired!

But what is to be done about it? The lags of which we are complaining are intrinsic to the physical systems through which the man is attempting to act. This can be illustrated admirably by considering the steering characteristics of a ship. Figure 1 shows the display, pilot, and control as the three upper boxes, with the steering characteristics diagrammed below. The rudder of large ships is moved by steering engines, the more primitive of which turn the rudder, not instantaneously, but at a rate which is proportional to the displacement of the pilot's control. Thus, the rudder takes up a new position only after a time lag which is represented as DELAY 1 in the diagram. Once the rudder assumes a position either to the right or left,

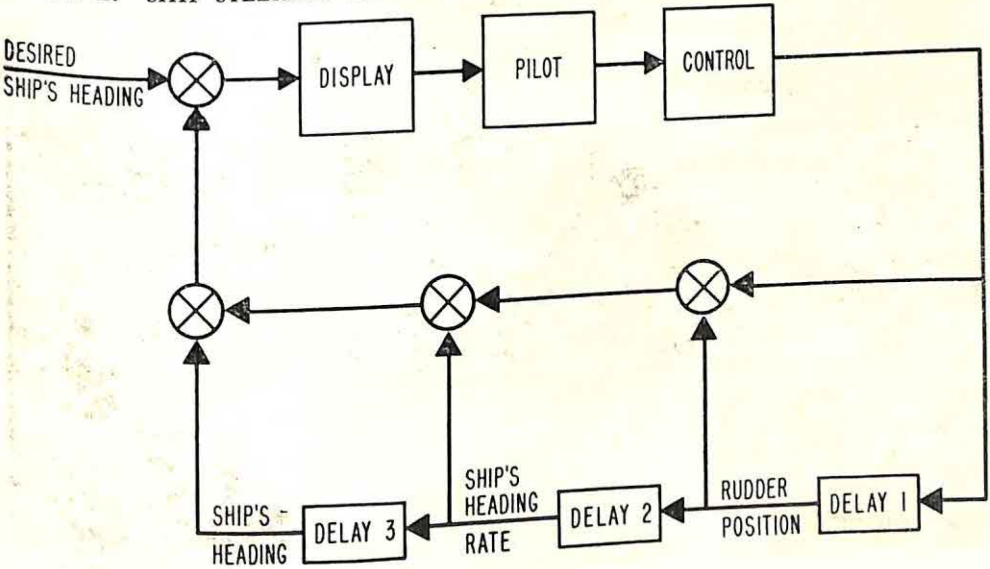
FIG. 1. SHIP STEERING CONTROL CHARACTERISTICS



the forward motion of the vessel causes unbalanced hydrodynamic forces to take effect upon the boat and to start the stern swinging to the side. However, owing to the inertia of the vessel, time is consumed in starting the turn and a second delay (DELAY 2), enters before the boat is turning at a constant rate. Finally, after additional time passes (DELAY 3) the ship takes up its new heading and the process is complete.

Taken together these lags conspire to present the pilot with a very difficult task owing to the fact that the time delays produce a loose display-control relationship for which he must compensate if he is not to overcontrol first in one direction and then in the other. Furthermore, it is apparent that the

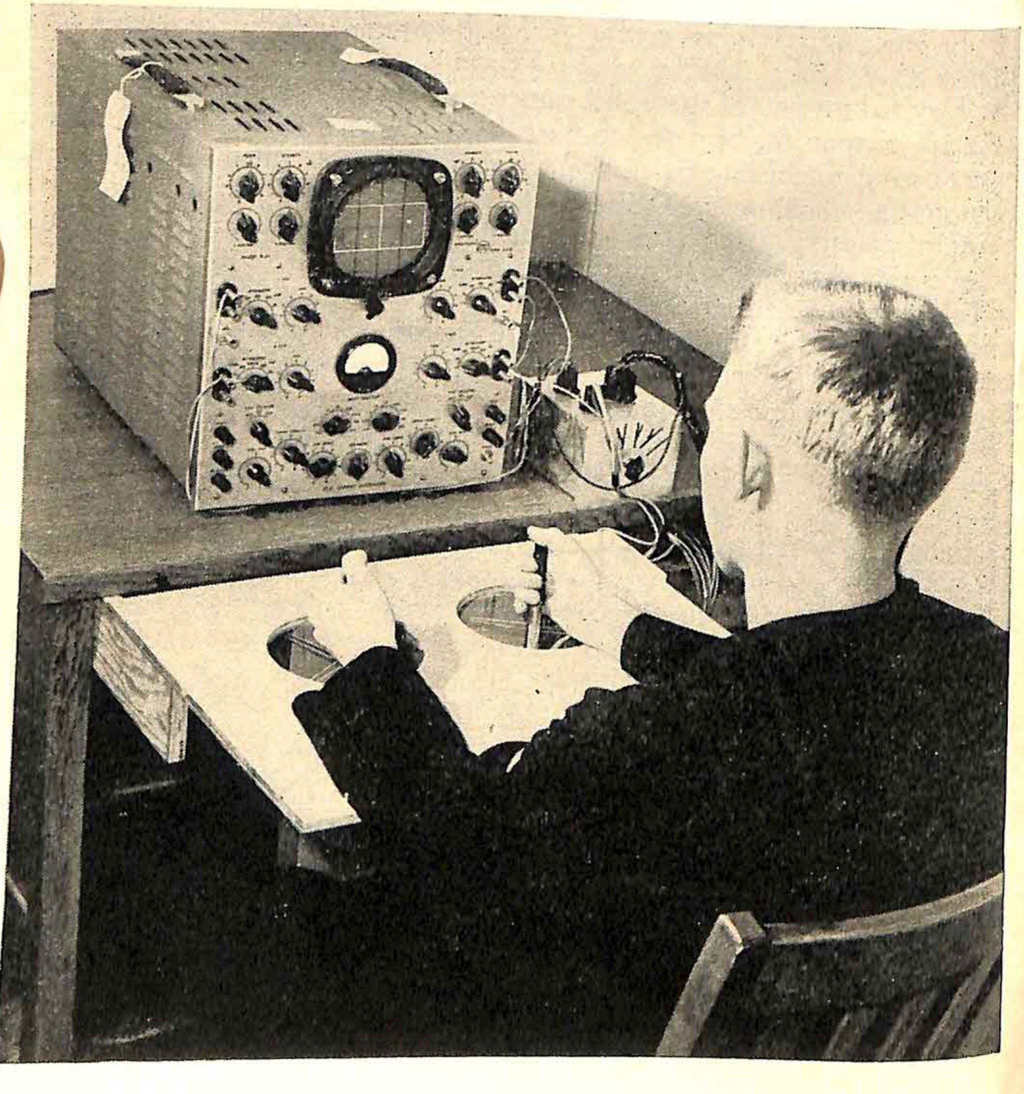
FIG. 2. SHIP STEERING CONTROL CHARACTERISTICS SHOWING QUICKENING



delays cannot be removed from the pilot-ship system since they result from immutable mechanical and hydrodynamic laws. Nothing can be done to make a ship change its heading instantaneously!

Yet a solution is possible. Although the lags cannot be removed from the system as a whole they can be taken out of the display through a process which has come to be known as 'quickening' (Birmingham and Taylor, 1954). This process simplifies the controller's task by giving him immediate knowledge of the eventual effects of his control motions. This task simplification is accomplished, as is shown in Fig. 2, by picking off control position, rudder position, and ship's heading rate, amplifying them properly and adding them algebraically to ship's heading as it is fed to the display. Now the pilot's task becomes the simple one of tracking through a tight and highly responsive control loop. Instead of having to act as a complex

FIG. 3. FOUR-COORDINATE TRACKING TASK

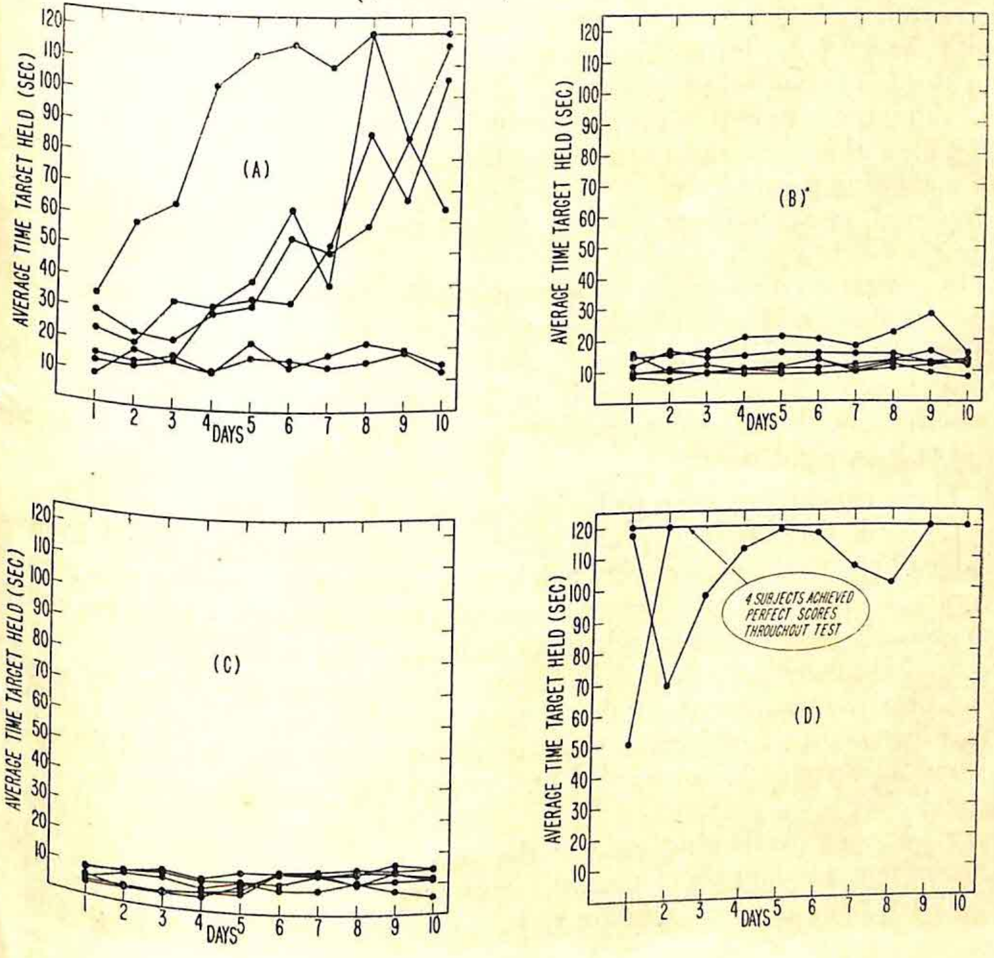


anticipating device he can now act as a simple amplifier, for he has immediate knowledge of results.

Tests run at the U.S. Naval Research Laboratory with a device simulating a vessel have shown that rather astonishing improvement in man-machine control system precision can be achieved through this means of processing and displaying information to the operator. Improvements in performance have been achieved through display quickening in simulated fixed-wing aircraft, helicopters, submarines, and in gun laying equipment. It may also be useful in improving the control precision of such industrial devices as lathes, derricks, cranes, etc. But the greatest advantage from quickening is achieved when several control coordinates are dealt with simultaneously as is shown in a study by Birmingham, Kahn and Taylor (1954).

In this experiment a four-coordinate tracking task was employed wherein the subject manipulated two joy sticks to hold within view two target dots on a two-gun cathode ray tube (Fig. 3). Each dot was free to move up and down and left and right, thus providing four separate

FIG. 4. LEARNING CURVES FOR 1-, 2-, AND 4-COORDINATE (QUICKENED) CONTROLLING



control coordinates. Due to unbalances in the system, the target dots would wander off the scope face in about 30 seconds if the subject made no effort to control. Into each of these coordinates were inserted three delay stages of the type described earlier in the ship control system.

The subject's success in tracking in one or two coordinates without quickening was compared with his results when he tracked all four coordinates with quickening. In Fig. 4 are shown learning curves from six naval enlisted subjects, with the performance of each subject plotted separately. The values on the ordinate and abscissa are the same in all four conditions. The ordinate values show the time the target was held, with 120 seconds representing a perfect score, since this was the criterion aimed for. Each curve represents ten successive days of practice.

In condition A the subjects were controlling in only one coordinate without quickening. The left-hand joy stick was manipulated to control the left dot which moved only horizontally. It is clear that four of the six subjects exhibited learning, although only one subject achieved three successive perfect trials.

In B and C the subjects were attempting to control simultaneously in two coordinates without quickening. Curve B shows the results when the subjects were trying to track the vertical and horizontal drift of the left spot with the left-hand joy stick. Curve C represents the results where the dot on the *left* is controlled in one coordinate with the *left-hand* stick while the other dot is moved in the other coordinate with the right-hand joy stick. It is clear that these tasks were too difficult to allow individual differences to show or to permit learning. Thus, we may conclude that, with the delays employed, one-coordinate tracking pushed the average subject to his very limit.

In contrast to these results without quickening, observe what was obtained in condition D. Here the subjects were controlling simultaneously in four coordinates, but with quickening. As is stated in the figure, four of the six subjects achieved perfect scores from the first day on. One of the subjects required one day to achieve perfection, while the poorest subject mastered the task in eight days.

Three conclusions seem to be in order:

1. Task simplification produced by providing immediate visual knowledge of results through display quickening increases the number of separate control loops which an operator can handle simultaneously. Four are easily mastered with quickening whereas one is the limit without it.

2. Man-machine system design aimed at simplifying the controller's task can greatly minimize the training problem. This is indicated by the fact that five out of six subjects achieved perfect scores in the quickened situation from the second day onward. This same finding also leads to the third conclusion.

3. Proper quickening reduces the problems of personnel selection by increasing the number of potential operators.

When these three benefits are added to the enhanced system stability and precision which are the primary products of quickening, it becomes easy to appreciate the surprising power of this task-simplification approach when it is applied properly to the design of instrument displays.

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The Effect of Initial Pointer Position on Display-Control Relationships

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INTRODUCTION

FOR efficient equipment design it is often necessary to know which direction-of-movement relationship between display and control will be used by operators unfamiliar with the equipment. The 'naturalness' of the display-control relationship may determine the level of continuous performance (cf. Loveless, 1956); it will almost certainly determine the initial response, which may be critical in the case of a sensitive or dangerous control. While there is a good deal of information about which directions of movement are expected or natural in different display-control arrangements, there is no solid evidence on a variable which is likely to affect initial responses—the position from which the pointer or other display indicator begins its travel.

Work by Bilodeau (1951) gives some support to the suggestion that the initial position of a display indicator influences the choice of direction of control movement. His study may be interpreted as showing a continuous decrease in the number of preferences for control movement in the predominant direction, as the position of a display light moved nearer the end of the scale. Such other evidence as exists does not confirm the suggestion, however. Warrick's (1947) study of displays and controls in various relationships uses two starting positions in each direction, but there is no consistent change in the proportion of predominant responses.

Bilodeau's criterion was not a control movement, but the imagined response of a subject, who was asked which direction he thought a light would move for a given control movement. This procedure places reliance on the unknown correspondence between imagined and actual responses; and it also reverses the usual, more appropriate method, which is to find which control movement is used to produce a given result on the display. In addition, the use of a scale consisting of discrete lights, together with lever controls appears to limit the generality of the finding.

The present experiment was accordingly designed to investigate a larger number of initial pointer positions, in a situation where (a) the predominant display-control relations were comparatively unambiguous, (b) the scale was continuous, (c) the display movement, not the control movement, was preset, and (d) an overt motor response was recorded.

METHOD

The apparatus was an arrangement of 'Meccano' gears and pulleys, enclosed in a rectangular hardboard box. A 2″ rotary knob, halfway up the right side of the box controlled a ½″ pointer travelling over a 6″ vertical scale inset centrally on the front panel. The scale was marked at 1″, ½″, and ¼″ intervals, the top and bottom marks being each ¼″ from the bezel. When a given direction of movement of the pointer was preset, rotation of the knob in either sense gave rise to movement of the pointer in the preset direction.

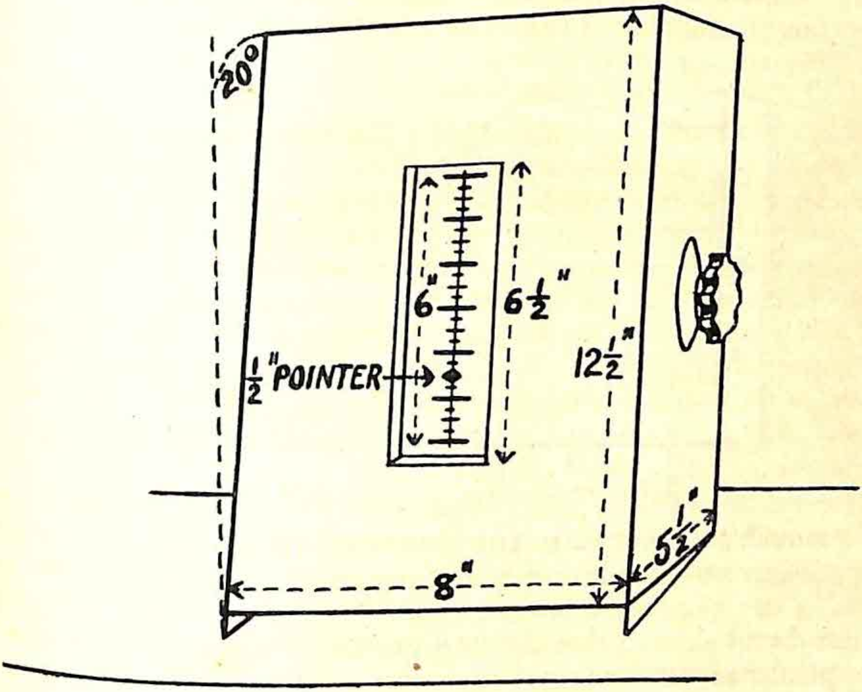

FIGURE I: THE APPARATUS

Three hundred and sixty students of various faculties were used; 210 were male, and 150 female. They were divided into 18 groups of 20, with groups at 9 different initial pointer positions for each direction of pointer movement. The pointer positions were at 0, 1, 2, 3, 4, 5, 5¼, 5½ and 5¾ inches from the beginning of the scale relative to the direction of pointer movement. The ratio of men to women was approximately equal for all groups.

Each subject was used only once, to avoid transfer effects within the experiment. He was asked if he was right- or left-handed, and the hand which was used for writing was noted in case of doubt. The subject was seated in front of the apparatus, which was at a position between eye and elbow height, and inclined away from him at 20° from the vertical. The subject was then asked to set the pointer to a position 1″ up or down from its starting position (or in the case of the last three positions, to the end of the scale), using his right hand regardless of handedness. In the few instances when the experimenter was asked which way the control worked, the reply "Twist the knob" was adequate to produce a response. The direction of rotation of the control knob used by the subject was recorded, in a code designed to give the impression that accuracy of setting was being investigated, so as to prevent bias caused by any spread of information about the experiment.

RESULTS

In Figure 2, the number of clockwise responses for each group is plotted against the positions on the scale from which the pointer movements commenced. The number of anticlockwise responses at any position is obtained by subtracting the number of clockwise responses from 20.

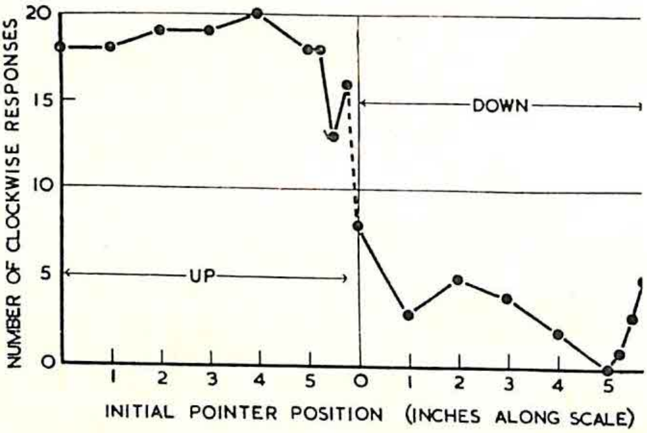

FIGURE 2: DECREASE IN THE NUMBER OF RESPONSES IN THE PREDOMINANT DIRECTION AT BOTH ENDS OF THE SCALE.

Analysis by χ^2 showed that the total number of clockwise responses for upward pointer movement (159/180) was not significantly different from the number of anticlockwise responses for downward movement, (149/180). Analysis of responses by men and women subjects showed no significant sex differences. Similarly, the responses of left-handers, who formed 7.2 per cent of the population, were not significantly different from those of right-handers; this does not therefore confirm the left-handers' significant bias towards anticlockwise response found in a previous experiment (Holding, in press).

Further χ^2 analysis, by Brandt and Snedecor's method for $2 \times N$ tables, showed that it was possible to combine the results of the up and down series. Number of responses in the predominant direction, (i.e. those clockwise for up, combined with those anticlockwise for down) was therefore plotted against inches distant from the beginning of the scale, (i.e. from the bottom for clockwise responses, and from the top for anticlockwise). The curve thus obtained showed that the proportion of predominant responses depended on the initial pointer position; this was confirmed by χ^2 ($p < 5\%$). It was decided to test the hypothesis that the ends were significantly different from the middle. Positions 0″, 5½″, and 5¾″ as a group were significantly different ($p < 0.1\%$ by χ^2) from the group formed by the remaining middle positions. The average proportion of responses in the predominant direction was 90 per cent for the middle positions, against 76 per cent for the three positions in the end half-inches of the scale—a difference of 14 per cent ± approximately 4 per cent.

DISCUSSION

The main finding of the experiment is that the initial position of a display pointer does influence an operator's choice of direction of control movement, even in a display-control arrangement where a clear stereotype exists. It seems likely that the effect would be stronger in a more ambiguous arrangement, for instance where the display is at right angles to the control, and it would be interesting to know whether this is the case.

The results partially confirm Bilodeau's finding in as far as the proportion of responses in the predominant direction is reduced toward the end of the scale. Bilodeau's steady trend from the beginning of the scale is not however reproduced. The findings of both experiments might be explained by a hypothesis of an incremental tendency for responses opposite to the predominant one, which developed as the end of the scale was reached. The zero point of the opposing tendency, and its rate of increase would not be the same in the present case and in Bilodeau's. In the present case, it would be necessary to assume that the competing tendency developed later, and that it had still not reached full strength by the time that it had become the predominant one on the way back down (or up) the scale.

Such a tendency would be opposed by the experimenter's instructions until the end of the scale was reached, and reinforced by instructions on the way back. As such reinforcement is found not to produce maximum predominant response at the beginning of the scale, less weight must be given to the effect of the instructions than might have been supposed. In fact, on the evidence from the end of the scale alone, it would have to be assumed that subjects tended to deduce the nature of the task from the perceptual structure of the situation, to some extent independent of instructions. The case is thus analogous to Ach's early experiment, reported by Gibson (1941), in which an attempt was made to compare the strength of an instruction-induced set with an earlier established habit. The effect of such a habit in the present case may be regarded as negative transfer brought about by the fact that there is usually a higher probability of the pointer moving toward the middle of the scale than toward the end it has nearly reached. The instructions only describe the goal of the activity, which is to some extent presupposed by the subjects; reference to the means of attaining the goal would presumably have commanded more attention.

SUMMARY

The paper describes an experiment on a new variable in display-control relationships, showing that the position from which a display indicator begins its travel has an effect on the direction in which a control is moved by an operator who is unfamiliar with the equipment.

Settings on a vertical scale were made by means of a rotary knob. Half the settings were made upwards, and half downwards. The initial positions of the display pointer were at nine different distances along the

scale for both groups of settings. There were 360 subjects, in 18 groups of 20 each on each initial pointer position. The direction of rotation of the knob—clockwise or anticlockwise—was recorded.

The predominant display-control relationships were: clockwise rotation for upward movement of the pointer, and anticlockwise for down. The pattern of responses for upward pointer movement was similar to the pattern for downward movement. The number of responses in the predominant direction was about 14 per cent less when the pointer began at either end of the scale than when it began in the middle.

ACKNOWLEDGMENTS

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Book Reviews

Social Class and Educational Opportunity. By J. E. FLOUD, A. H. HALSEY, and F. M. MARTIN. London: Heinemann, 1956. Pp. xx + 152. Price 12*s.* 6*d.*

"Is the grammar school today open to all on equal terms regardless of social origin? Do social factors continue to influence educational selection?" These are the questions, according to the publisher's description, which this book attempts to answer with factual evidence from two extensive surveys in Hertfordshire and Yorkshire. In each area a representative sample of boys was chosen; their homes were visited and parents interviewed; their school records and test results were studied; and records dating back to the beginning of the century provided a historical review of the topic. The resulting report bears the stamp of efficiency throughout: it has been well designed and carried out with thoroughness, and it is presented in a competent style which avoids the hazards of speculation by drawing precise conclusions from some 40 excellent tables and diagrams.

A major difficulty in social research is to secure adequate measurement of variables, and the authors recognise the limitations imposed by the measures they have chosen. The 'educational opportunity' of the title is limited, for most of the book, to entry to a grammar school; 'social class' is father's occupation; and the 'ability' of children is their intelligence test scores. The inclusion of the last of these is a welcome corrective to the naive assumption in some quarters that equality of opportunity means equal proportions of children from each social class admitted to higher education. Obviously, one must take into account differences in ability between children. The authors do this, and show that, after many years of inequality, the social class distribution of grammar school entrants now corresponds remarkably closely with the distribution of measured intelligence. Insofar as the system of selection involves intelligence tests, together with other assessments which show a high correlation with intelligence—the correlation between the selection totals and intelligence test score would be, I calculate, about +0.9—the finding is only a confirmation of what might have been deduced from the system of selection. It is nevertheless valuable as such confirmation. Since the inquiry was made, one of the areas has abandoned the use of intelligence tests: it would be interesting to know what effect the change has had on the social class distribution of grammar school entrants.

The authors show from further inquiry that the effect of social class has now moved from selection at age eleven to a selective early leaving from grammar school courses. In this respect, they have suffered the misfortune of having their findings anticipated by the Advisory Council's report on *Early Leaving.*

The scope of the inquiry was also extended to examine the relation with grammar school entry of certain features of environment—the material prosperity of the home, the size of family, the educational experience of the parents, and the quality of primary school buildings. These are for the most part considered separately, and generally show some association with educational progress. Though the title of Chapter 6 refers to these as "social factors in selection", they are correlates rather than factors, and a much more elaborate analysis would be required to isolate factors among such assessments of background. The most complicated statistical term in the book is percentage. These features of environment all interact, and, to judge from the findings, apparently do so in different ways in different communities. In attempting to deal with this extremely intricate network of social, cultural, and material influences, without statistical analysis, the report becomes increasingly complicated, until the last five paragraphs of Chapter 6 average 50 words a sentence. Fortunately, the tables are lucid.

A full answer to the question of equality of educational opportunity would seem to require a disentangling of social influences on intelligence test scores, and information on the part played by intelligence in social mobility. The results make a contribution to knowledge on both these topics. Yet this book is in danger of suffering from the over-ambitious claims made for its findings in advance publicity and in newspaper reviews which have sought merely to abstract a few facts to pass on to readers.

There are certainly useful data here (though the statistical significance of results is not given). But the authors themselves repeatedly emphasize the limitations of their investigation. Its importance lies not so much in the results reached as in its contribution to the general trend of research in this field. To give an example, two contrasting areas were studied: the results show some striking differences between the two areas. Though at first it may seem disappointing that no simple rule can be given on the relation of social class to educational opportunity, this is not a weakness in the findings since it points clearly to the need for a more subtle approach to the problem.

The rapid development of sociology promises to enrich both psychological and educational research in the same way as the introduction of biological concepts has done in the past. The precise restriction of this inquiry within certain limits constitutes one of its valuable features, in that it provides a sound basis for future work. A follow-up of the group studied here is promised. There will certainly be other studies which will use the data set out in this report as a starting-point. This book must be regarded as marking an important stage in the development of research in the borderlands of sociology, education and psychology. J. D. NISBET

Communication: Handling Ideas Effectively. By ROY IVAN JOHNSON, MARIE SCHALEKAMP and LLOYD A. GARRISON. London: McGraw-Hill, 1956. Pp. x + 362. Price 34*s*.

"Read not to contradict or confute; nor to believe or take for granted—but to weigh and consider." So said Bacon; but with all respect due to a father of British Science, there are now more books in this world than he, poor mortal, dreamed of; and although some present their information in a reasoned fashion so that we are invited to weigh and consider, others are obviously intended to be believed and taken for granted, whilst others positively beg us to disagree and confute.

This book is of the second kind, being firmly educative and determinedly useful in its intention. Its object is to help the individual who wishes to teach himself how to communicate. Beginning with chapters on systematic study and note-taking, the proper use of reading and sources of knowledge, it goes on to consider systematic listening, dealing with ideas and effective expression. From these the authors turn to more practical matters such as the art of discussion, making reports, writing letters and use of language.

It would be easy to criticise this book on the grounds of superficiality, but in its defence it could be argued that it is written to be intelligible and helpful to people who know or feel that they need help, and not to convey information simply because the authors as educators feel that they ought to know it. This last point is a criticism which is often made of the educational system of this country; that Latin, for example, is taught to children not because the subject will be of use to them in later life or because they want to learn it, but because it is said to cultivate the faculty of reason or to be character building, or that it disciplines the mind. We shall not enter into this argument, but would merely observe that while any educational system might at least be expected to teach people how to express themselves effectively in writing and speaking their mother tongue, that is, to communicate, it is still worth while our reviewing this book, as there are a considerable number of people in all walks of life who could read it with profit. DAVID C. DUNCAN

The Presentation of Self in Everyday Life. By ERVING GOFFMAN. Edinburgh University: Social Sciences Research Centre, 1956. Pp. x + 162. Price 10*s*.

This monograph is something out of the ordinary. Its content can perhaps be characterised by reference to an experience of the reviewer, who once had the misfortune of accidentally lifting a cover under which a conjuror was concealing a pigeon: the author deliberately lifts the different covers under which performers in the most varied spheres of life hide their secrets from their audiences. The homely concept of 'social role' is given a new look by supplementing it with an account of what goes on back-stage.

The whole analysis is cast in dramaturgical terms, its aim being to show that much of social behaviour can be interpreted as 'impression management' on the part of performers, singly or in teams. The different means employed in the attempt to induce the audience to perceive the performers in certain desired ways are discussed with copious illustrations, drawn from a diversity of fields; *e.g.*, courts of oriental potentates, highland crofts, mental hospitals, army units, shoe shops and ship yards. A great many bits of unusual and quaint information are provided, often culled from Ph.D. theses buried in American libraries. Here is an example:

> "Those who sell men's clothing learn that the gruff show men maintain of being little concerned with how they look is merely a show and that strong, silent men will try on suit after suit, hat after hat, until they appear in the mirror exactly as they want to see themselves."

Many readers will be led to scrutinize the less public aspects of their own professional roles, and at least one reader did not escape a certain sense of discomfort in doing so. This is no doubt very salutary, as it may result in a questioning of the —as a rule traditionally accepted—front one feels obliged to present to the audience. Thus all those, from captains of industry downwards, who are not afraid to look at themselves and their colleagues as they do not want others to see them can be recommended a perusal of this original, if somewhat disconcerting, study.

GUSTAV JAHODA

Organising for Production. By B. H. DYSON. Birmingham: Institute of Industrial Supervisors, 1956. Pp. 20. Price 2*s*. 6*d*.

This pamphlet is a reprint of an address delivered to the London North-West Section of the Institute of Industrial Supervisors. Its argument is that productivity can be improved substantially by concentrating attention on a number of separate factors. Some fourteen of these factors are briefly discussed under the four headings of Manufacturing Administration, Designing for Production, Material Utilization and Production Engineering. The sections on Designing for Production and Material Utilization are particularly interesting.

One should not expect too much from this pamphlet. In so few pages it can only say a very little about each subject, and to think that this is all there is to be said on any one of them would be to take a very limited view; like the Scotsman who visited Edinburgh for the day. He was much impressed by Waverley Station, so much so that he spent the day there, and reported to his friends on returning that Edinburgh was "very fine, a' under glass". One can, however, be enlightened by these pages, into realising that there are these approaches, and the account of them is interesting enough to make one wish to go on to find out more about them.

DAVID C. DUNCAN

Automation in Theory and Practice. Edited by E. M. HUGH-JONES. Oxford: Blackwell, 1956. Pp. x + 140. Price 12*s*. 6*d*.

Generally speaking, we are creatures of habit. Learning new tricks, especially for old dogs, is a fatiguing business, and if a habit can be established whereby another routine of our daily lives can become automatic, so that we need not think about it, we save our energies. In the extreme, if our habits are threatened by change, it may be worth devoting almost all the energy that would be required to break the old habit to resisting the change. Some changes of course must occur and we become used to a general and continuous adjustment in the face of necessity.

Radical change is a different and more serious matter. It requires first the acceptance that it is inevitable and that the old habits must be broken and new ways learned in their place. It also requires very full information to those who must change as to what adaptive action is relevant and necessary. In industry there is an accustomed rate at which change takes place and social problems can arise if change becomes too widespread all at once, or if it occurs at a rate higher than those in industry are prepared to accept.

This, however, is a well-worn topic. Resistance to change has been studied in various forms by social scientists for a long time, and economists and sociologists have been arguing about the problems of rapid technological change for decades. It is a remarkable thing, therefore, in fact it cries out for examination by psychologists, that because this topic is presented in a new guise so that it looks unfamiliar, we are forced to re-examine it and form new attitudes about it. For the problem of automation is no more, and is probably less, than the problem of rapid change.

A reading of this book will make this clear. It comprises addresses delivered at Oxford University by seven speakers, two physical scientists, an engineer, a trade unionist, a business consultant, a social psychologist, and an economist, who also edited the book; all the addresses, if we are to believe the title of the book, centre round the theory and practice of automation.

If this were so, we should be in for a difficult time. Automation, strictly speaking, is a complex feat of electro-mechanical technology, and a book on its theory and practice, although possibly a bible for the production engineer, would be a closed book for the businessman and the social scientist. However, as it turns out, the speakers concern themselves not with the subject of the book title, but with the meaning and implications of automation. Nor is this all. Lord Halsbury, in his introductory address, deals ably with both topics. But he points out that at the rate at which automation is likely to be introduced in this country it is unlikely to cause any great social disturbance. This conclusion is echoed by most of the other speakers, and is in fact the principal conclusion of the book. So that insofar as the speakers are talking about live, and not merely theoretical social problems, they are discussing the social problems arising from rapid technological change. In this lies the real content and value of the book.

Considered as a contribution to the literature on social problems of rapid change, the book will be found easy to read, stimulating and informative. In particular, the contributions by Michael Argyle and the trade union leader, H. R. Nicholas, are well worth reading. The inclusion of a consultant in a discussion of radical change is also appropriate. Outside advisers are probably of least service in ensuring that continuous adaptation to circumstances and regular change takes place in a company. But where things have reached the stage where radical change is necessary or where the radical step of introducing completely new routine procedures must be taken, consultants can be of great assistance as 'midwives of change'. Mr Spencer, in considering how electronic computors can help the office manager, is hitting at the heart of the matter, since the products of paper routines are without exception the most common form of mass production in business today.

One is forced, however, by this book, to the conclusion that the word 'automation', despite attempts to give it a respectable scientific meaning, is in effect a 'gimmick', to serve to draw attention to the implications of rapid technological change. The American writer, Diebold, who originated the word seems to have intended this, since he defined automation as "an attitude of mind aimed at making the maximum use of the resources available in the form of manpower and machines and the other expenditures in a business"; in other words, an attitude of mind prepared to accept rapid change and to bring it about.

This is not to say that the topic was not worth re-examining or discussing. If people, as a result of hearing about, reading about and talking about automation, are prepared to accept change, and to receive the information necessary to increase the rate of change, then the method of drawing it to our attention is worth noticing. One comforting thought, now that the book has been published, is that it should now be safe to avoid defining automation by the formula 'my meaning for the word is the one generally understood in the public houses of Oxford'. DAVID C. DUNCAN

L'Evolution du Travail Ouvrier aux Usines Renault. By ALAIN TOURAINE. Paris: Centre National de la Recherche Scientifique, 1955. Pp. 202. Price 1,200 francs.

The Centre d'Etudes Sociologiques in France has been undertaking enquiries to discover and observe the effects of technological change on jobs in some characteristic French industries. The aim is to examine the nature of and the demands of skill in jobs as carried out at different dates, *e.g.*, 1920, 1935, and 1948, in order to throw light on the cultural problems of working life in our time. The investigation at the Renault factories described in this book is but a small part of the total inquiry.

Mr Touraine begins by explaining that he has analysed only a certain aspect of the work situation—the qualitative and quantitative changes in the nature of the work and hence of the place in the firm of the efforts of different categories of workers. In other words, he has examined the situation in which the worker finds himself, and not the feelings and attitudes of the man placed in this situation.

The book is divided into two main parts. The first describes the different stages of technological development through which manufacturing industry, and especially automobile construction, have evolved and are at present passing. The author identifies these stages of evolution, distinguishing them by sociological as well as by manufacturing differences. The second part of the book discusses the changes in human aspects of the job done by the worker which arise from the technological evolution described in the first part. A chapter is given to each of the main categories of worker affected: craftsmen other than toolmakers and maintenance men, toolmakers, higher grade semi-skilled workers (l'ouvrier spécialisé supérieur), setters, supervisors and fitters and electrical maintenance men.

The book as a whole is disappointing, despite valuable individual sections. It tantalises with information of interest about the highly specialised multiple machine-tools and machine-transfer lines in one of the most highly automated car producing plants in Western Europe, and about some of the human and organisational problems involved. But it leaves some of them incompletely dealt with in order to indulge in abstract and wordy discussion of intangibles of little interest and value either to the industrialist or to the industrial psychologist. In a few places the attempt to disentangle valid deduction and forecasting from abstract speculation becomes tedious to the reader. A further weakness is that nowhere does the author set out the method adopted in the inquiry; he goes straight from the aims to the findings, although the bibliography and acknowledgments for the help of management, supervision and the trades union strongly suggest the author's sources. He appears to have adopted an historical approach; his findings and hypotheses might have been more telling if, in studying the repercussions between technological change and the workers, he had manifestly asked the workers for their feelings and opinions.

In its first part, dealing with technological evolution, the book makes a useful contribution in pointing out the differentiated functions of universal, specialised and composite machines, from the centre-lathe to machine-transfer. These three types of machine form the bases for the author's three phases of evolution. In the second part are brought together and presented items of information on, for example, human aspects of the evolution of the trades of tool-making, the progressive specialisation of toolmakers, and, quite recently, of setters and supervisors, too. These, too, are interesting, as is the author's conclusion that in the transition from highly specialised machines (*e.g.*, automatics) to true automation (*e.g.*, machine-transfer) the social features of the work tend to be most important, and may even outweigh the vocational features. This will encourage those concerned with human relations and morale in industry to continue to train for and promote improved relationships, whether the impending technological changes in this country come soon or late. It is a pity, however, that Mr Touraine's book does not contain more information on how the training problems accompanying these changes were dealt with in the Renault plant. This is a topic of particular interest to managers and training staff in this country, and would seem to have been a relevant subject for description and comment in a book with this title.

BRET HARDING

Människan i Industrisamhället. Volume 2. *Fritidsliv-Samhällsliv.* By TORGNY T. SEGERSTEDT *and* AGNE LUNDQUIST. Stockholm: Norstedt & Söner, 1955. Pp. 488 + lxx. Price Kr. 25.

Information pa Arbetsplatsen. By EDMUND DAHLSTRÖM. Stockholm: Studieförbundet Näringsliv och Samhälle, 1956. Pp. 324. Price Kr. 14:50.

These two books from Sweden are evidence of the growing interest in sociology and industrial psychology in this prosperous democratic country. The former book is the second volume of a major work whose English title is *Man in Industrial Society*. The first volume was called *Life within the Plant*. The second is *Leisure Time and Community Life,* and it describes a large scale survey in which comparisons were made between a wide range of activities of the inhabitants of two towns: Huskvarna is old, and Katrineholm is modern and industrial. Extensive use was made of questionnaires and interviews, and information was obtained about individual participation in every sort of activity; political, cultural and recreational.

Generally, the Swedish worker regards his trade union rather than political organisations as having played the greater part in the improvement of working conditions. This does not seem to produce any conflict of loyalties, however, and the black-coated worker whose parents were of working class origin remains loyal to his traditional political institutions. With the reduction in the proportion of the community belonging to social class V and an increase in social class III, it might be thought that there would be a weakening of the traditional working class political institutions. These studies showed the opposite to be the case. The text is supported by some 300 tables. The English summary that is promised should take its place among the current sociological literature dealing with changing housing conditions and their effect on ways of life of the community.

Internal Communications also is described as a sociological study, but here the area of interest is the factory and the topic is that of communications between management and the worker. The object of the volume is "to state problems, develop hypotheses and suggest further research". The case studies described generally follow the now well recognised pattern of informal relationships and unplanned patterns of communication playing a more important part than that presumed by the organisational chart. It is suggested that there is need to examine the problem of the influence of communications on internal relationships in place of the more classical studies of the effects of organisational and other conditions on flow of information. The naïve acceptance by some of a simple faith about the value of good internal communications is criticised and the complex psychological factors which upset any such simple theory are stated.

The case study of the joint consultative body of a heavy industry plant is described briefly in the English summary, which is most tantalising, for though many of the main points are familiar in the field of group and human relationships, the particular incidents are only hinted at. The difficulty of the company's chairman, with the dual role of chairman of the committee and leader of the management side; the existence of sub-groups and the interaction between sub-groups; language barriers between groups; the poor communication between representatives and those they represent, are all situations familiar to us. Perhaps we should not be surprised that in Sweden, with its highly democratic industrial society, enjoying a standard of living which is unsurpassed in Europe, the stresses and strains of employer-worker communications do not appear to be greatly different from those of Britain and America.

Certain hypotheses as to the determinants of success in joint consultation are put forward. Admirable as this list may be, the testing of such hypotheses is manifestly a most difficult experimental problem. Contact with industrial psychologists in Sweden has led us to expect a high standard of experimental design, and painstaking and careful work. The closing sentences of this book suggest that we can continue to expect this in the future. The author, looking forward to future research, stresses the "necessity of careful analysis with empiric testing of concepts and hypotheses".

These are two books which we should like to see in English translation in full.

H. G. MAULE

The New Psychology for Leadership. By DONALD A. and ELEANOR C. LAIRD. London: McGraw-Hill, 1956. Pp. 226. Price 30*s*.

The Lairds are thoughtful popularisers; and as such they deserve sympathetic attention. Their enterprise is bold, because it is apt to draw disdainful comment—when it draws any at all—from their academic colleagues; and it is hazardous, because it is very difficult to carry through as successfully as the preparation of a paper for a scientific journal, which, by comparison, is child's play. But it is not only bold and hazardous: it is desirable, too. How else is the psychologist to reach his 'user'?

This seems to be the twelfth book the authors have done together. Its aim is to give an account of the main findings of research workers, from 22 research centres, on leadership. "The technical terms are left out, and replaced by words from everyday and business life. The reports included are typical of the trends, and deal mostly with face-to-face leadership at the first level." The whole thing is liberally sprinkled with 'chartoons' checked by a senior member of each research team concerned. The number of checkers who shuddered a little as they checked is not reported.

It would be easy, but rather unfair, to criticise the book on the ground that its accounts of researches will often leave the inquisitive reader without answers to important questions about samples and methods. There is a bibliography of 130 titles, nearly all of them dated between 1951 and 1955; and if the sketchiness of some of the material in the book stimulates people to make use of the list, it may have positive value. Although the dust-cover indicates that streamliners of supervisory techniques constitute the target readership, it seems likely to be used in this country by management course lecturers too.

ALEC RODGER

The Normal Child and some of his Abnormalities. By C. W. VALENTINE. London: Penguin Books, 1956. Pp. 292. Price 3*s.* 6*d.*

Many fields of psychological enquiry are contributory to an understanding of the psychology of childhood. Experimental psychology, psychometrics, psychopathology, sociological studies, social psychology and sociometry have all a part to play; and in this book some reference is made to each in turn. Professor Valentine is, however, concerned particularly with the comforting of parents or teachers who, through lack of knowledge of the wide range of individual differences at every age, may be tempted to label as abnormal many emotional reactions or irregularities in response which are both evanescent in nature and not uncommon. To the achieving of this purpose the book makes an admirable contribution. It is written in a pleasant conversational style, and his interpretations are abundantly illustrated with anecdotal records from observations made by himself and other psychologists and from investigations carried out by some of the many students and teachers who have engaged in psychological research under his encouragement.

His emphasis is throughout on evidence rather than theory and on the patient recording of observable data rather than the elaboration of hypothetical constructs. For this reason he casts doubts on certain of Freud's generalisations and on the over-clear demarcation into discrete stages derived from cross-sectional studies of the type undertaken by Gesell and his followers. He challenges the supposition that character-formation is entirely a matter of 'conditioning' or 'socialisation' and he indicates the normality of both affectionate sympathy and some degree of self-assertiveness. With these viewpoints many psychologists would today be in agreement. Of more controversial nature are his pronouncements on the use of the word intelligence and on the meaning of the results of intelligence testing. To a degree surprising in the author of *The Reliability of Examinations*, he continues to asseverate the constancy of measurable relative status and offers comparatively little challenge to the assumption that early failure will be followed by ultimate defeat. This is linked with an emphasis on the individual rather than the social determinants of learning which reduces the usefulness of the book for students of the psychology of educational processes. It is admittedly necessary to remain aware of the reality of individual differences. It is, however, desirable also to take full account of the modifiability of human responses as that is indicated in recent work in the field of social psychology.

C. M. FLEMING

Other Books Received

Annual Review of Psychology. Volume 8. Edited by PAUL R. FARNSWORTH *and* QUINN MCNEMAR. Palo Alto, California: Annual Reviews, 1957. Pp. x + 502. Price $7.50.

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Psychology of Personal and Social Adjustment. By HENRY CLAY LINDGREN. New York: American Book Co., 1953. Pp. x + 482. Price $4.50.

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The Benefit Formula in Unemployment Insurance. By M. T. WERMEL. Pasadena: California Institute of Technoloy, 1957. Pp. 28. Price $1.00.

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Bus Workers in their Later Lives: A Study of the Employment of 300 Drivers and Conductors from the Age of 60 Onwards. By F. LE GROS CLARK. London: Nuffield Foundation, 1957. Pp. iv + 26. A limited number of copies available free of charge.

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The Transition from Work to Retirement (2)

By MARGARET PEARSON

The first paper under this heading was published in the last issue of *Occupational Psychology* (*31*, 80-88). It described an examination of the employment records, from the age of 45, of 220 employed men; and an investigation of their attitudes towards retirement. The present paper reports how those who retired within the two following years were adjusting to their retirement, and in particular whether they had sought or obtained other work.

ADJUSTMENT TO RETIREMENT

IT appeared from the replies to the questionnaires sent to this group of men on the eve of their retirement that rather more than half of them thought they would like to continue at work after 65, mainly because they feared that retirement would mean financial hardship. Some thought that they would only be capable of part-time work, but the majority were thinking in terms of full-time day work, with perhaps minor adjustments. Two years later contact was renewed with those of the men who had replied to the questionnaire and who had by now reached the age of 65 and thus by the firm's ruling had been obliged to retire. In this way the investigator hoped to discover what was actually happening—whether or not they had sought or found other work, how they were managing financially, if their health had improved or deteriorated, and how they were employing their time.

On investigation it was found that 124 of the original group of 220 were still working, 17 had died, and 79 had retired, among whom were 10 who had done so prematurely for reasons of ill-health. Of these 79, 74 were still living in the area and available for interview, and were seen in their own homes. All were under 68 years of age and had been retired for less than three years. Hence what follows is a study of the early years of retirement when the difficulties and limitations of old age, such as incapacity and isolation, are only beginning to be felt, but years during which habits are formed and the adjustment to the new way of life made.

Most of the 74 men interviewed were living in small terraced houses in the central area of the city: 56 were married and living with their wives, and 18 were widowed, divorced or single. Only three of the 18 lived alone; 13 were living with relatives, and two who were in lodgings were living as members of the household. As many as 46 had their children, either married or single, living in the same house; and in 20 households there were young children, mainly grandchildren. Two men still had children dependent on them, and two others had adult dependants other than their wives. Even where the grown-up children were not living at home contacts were maintained with some, if not all, of them in all but a few cases. Only three of the men who had grown-up children (66 out of the 74 men interviewed) had lost touch with them altogether, and while four only saw them occasionally, they corresponded with them regularly. In all these cases the men concerned had friends and relatives whom they saw frequently. The general impression of the investigator was that family ties were strong, and that the children were doing all in their power to help their parents.[1]

All over the country elderly men are finding it difficult to obtain employment, and on Merseyside there are fewer openings than elsewhere, as unemployment is relatively widespread even among younger men.[2] Hence even those retired persons who are really anxious to find work are likely to find the search discouraging, and it is not perhaps surprising that only 15 out of the 74 men contacted were in employment. Of these 15, 4 were in full-time and 6 in part-time work, 2 were in casual work which might be full-time some weeks and part-time others, while the remaining 3 were irregularly employed in odd jobs such as decorating, gardening and joinery.

The kind of work obtained, hours worked and wages received by the 12 men in regular and casual work is shown in the following table:

JOB	HOURS	WAGES
Full time work		
Car Park Attendant	2 shifts: 5 p.m.—12 midnight. 8.30 a.m.— 6 p.m.	£5 week
Night watchman for small tyre firm	6 p.m.—7.30 a.m.	£4.10s. week
Watchman on docks	Day work	Rate for number of hours worked
Driller for shipbuilding firm	Day work	Rate for number of hours worked
Part time work		
Lift Attendant in block of offices	3 hours for 6 evenings a week	£1.16s. week
Boiler Keeper in block of offices	Alternating 7 a.m. — 1 p.m. and 1 p.m.—7 p.m.	£2 week
Doorman in block of offices	3 hours an evening. Number of evenings varies from week to week	6s. an evening
Cinema Attendant	5 hours for 6 evenings a week	£2 week plus travelling expenses

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[1] This agrees with the findings of other investigators. See *Social Contacts in Old Age*, a report of a Liverpool survey, University Press of Liverpool, 1953; and *Over Seventy*, a report of an investigation into the social and economic circumstances of one hundred people over seventy years of age, National Council of Social Service, 1954.

[2] At the end of June, 1954, about the time at which the follow-up survey was being made, 15,344 adults were signing on at Employment Exchanges in the area.

JOB	HOURS	WAGES
Part time work		
Bowling Green Attendant	From Easter to September, 4 days a week from 4 p.m. till dark	£2 week
Clerk in a small wholesale grocery firm	5 days a week. 10 a.m.—4 p.m. for 4 days. 9 a.m.—5.30 p.m. for 1 day	£2 week
Casual work		
Two general warehousemen	Number of days varies from week to week	£1.3s.10d. a day each

From this it can be seen that only one man was doing skilled manual work, and only one was employed in clerical work; the remaining 10 men were doing mainly light unskilled jobs. The wage for part-time work was in every case £2 a week or less, thus enabling the men to draw their full State retirement pension. The one man doing clerical work appeared to be badly paid for the number of hours worked. He himself mentioned this but added that if he had been paid what he considered a reasonable wage his State pension would have been reduced or forfeited and he would have gained nothing.

When questioned as to why they had gone back to work after retirement, all but one of the 12 replied that they were working primarily to supplement their pensions and to give themselves a feeling of independence, but some also mentioned that they missed the routine of going out to work and had felt bored and miserable at home. Only one of the group had enjoyed his retirement and would really have preferred not to have gone back to work. Seven men said that they had applied directly to the firm for the job or had heard about it from someone else, while 3 had answered advertisements in the local newspaper. The two men doing casual work had obtained it at one of the various accepted 'stands' in the city where casual workers collect each morning.

Of the 62 men who were not employed, 28 (45%) stated that they were not able or did not wish to work and 34 (56%) said that they would like to take a job. Eleven of the 28 who did not want work gave chronic ill-health as a reason: 7 of them had in fact retired prematurely from the firm. Although they were all pleased to be relieved of the strain of work, the men suffering from ill-health were finding retirement particularly difficult and lonely as they were having to adjust themselves not only to retirement itself but also to the limitations of a severe physical handicap. Three other men were unable to work because they had the care of sick relatives. 14 men said that they had worked long enough and needed and deserved a rest, the majority adding that they had enough money to enable them to live comfortably without working. A few said that if they had been asked by their old firm to stay on after pensionable age they would have done so, but they were not prepared to start a new job with a different firm among different people. Typical of the men who were enjoying their retirement, but who would have stayed on had the firm given them the opportunity, was the man who said:

"I enjoy the leisured life of retirement, for I can do Church work and other things I have never had time to do before. I also have enough money to be comfortably retired and enjoy it. If the firm had asked me to stay on, however, I would have thought differently at the time."

Another man expressed his feelings in these words:

"I've just had enough, I've been working since I was 12 and I'm enjoying retirement. I would have stayed on with the old firm, but I spent so long there that I wouldn't like to go anywhere else now. Of course it would be different if I needed the money."

Of the 34 men who said that they would like to take another job, 20 (including one man who had been prematurely retired) sought to impress the investigator with their desire for work, but only 14 of the 20 had made any attempt to obtain a job by answering advertisements or applying directly to firms, and only two of these had had any regular work since leaving the firm. Their applications were either refused or they received no acknowledgment. They considered that it would be useless to register at an employment exchange in view of the extent of unemployment among younger men. Two of the remaining 14 out of the 34 were obviously unfit, and 12, although they said that they wanted a job, appeared to the investigator to be rather hesitant and made such remarks as, "I feel a bit bored at times and could always do with the money. I'd contemplate it if a job of just the right kind turned up"; and, "I'd quite like a job to occupy my mind and for a bit extra money but I'm not over anxious and I wouldn't want my pension to be affected".

When the 34 who had stated they wanted work were asked why, the majority gave the need or desire for extra money as their main reason, but most of them also mentioned loneliness and boredom at home, particularly during the winter months. Typical of these was the man who said:

"I was quite pleased with it at the time, like a child with a new toy in fact. While summer lasted it was fine but afterwards it got monotonous and time began to drag. I missed the men and the work particularly when I didn't get out much in the winter."

Questioned about the kind of work they would like, most of the men were rather vague, their main request being, as in the replies given before their retirement, for any kind of light work, such as storekeeper, doorkeeper, machine minder, patrol man, watchman and labourer on light work. Asked whether they had any preference for working with people of all ages, with those of their own age, or by themselves, 15 men answered that they had no preference, 5 said that they would rather work with older men or on their own so that they would not have to compete with younger men, but 14 preferred to work with younger people, because, as one put it,

"Younger men have different ideas and more fun. Old men always get down to just one track of life—themselves and their ailments."

With regard to hours of work, 21 men said that they would take either full time or part time jobs, but as might be expected, only 4 out of the 34 were prepared to do night work. A number of men said that they had welcomed shift work when they were young, partly because it meant higher wages, and partly because it meant that they were at home frequently during the day and so they were able to see more of their children. As they grew older and their families grew up, the need for money lessened and they preferred a more regular routine and the opportunity of spending the evenings at home with their wives.

When questioned about wages, it was found that a number of men, particularly those wanting unskilled work, said that they did not expect to get the same rate of pay as they had received before their retirement; and on this point their ideas seemed to have changed somewhat since the previous survey. The majority expected about £2 a week for part-time and £5 to £6 for full-time work. The only men who thought that they should have more were tradesmen and those wanting clerical work. The £2 limit on earnings then in operation for men between 65 and 70 did not appear to make any appreciable difference to their desire for work, but it did seem to affect the kind of work required, as the men were hesitant to take on jobs for which they might earn £3 to £3 10s. a week, considering that with the reduction in pension they would be no better off than if they worked fewer hours for less money.

During the interview no attempt was made to obtain an accurate and detailed account of each man's income, but a certain amount of information was available. All the men interviewed were receiving a pension from the firm. In only 3 cases was this less than £1 a week and for three-fifths of the group it was over £2 a week, as is shown by the following table:

WEEKLY AMOUNT OF FIRM'S PENSION	NUMBER OF MEN
Less than £1	3
£1 to £1.10s.	10
£1.10s. to £2	17
£2 to £3	29
£3 to £4	12
£4 to £5	2
More than £5	1
	74

Although no specific information was obtained, it may be assumed that all these men were in receipt of the State retirement or disablement pension in addition to the above amount; 12 were working and in six cases their wage was sufficient to involve a reduction or forfeiture of the State pension. In 10 other cases the wife was working or the man was in receipt of a pension from another source. Furthermore, 50 of the 74 men were either heads of households in which others were also contributing towards the household expenses or were themselves contributing towards someone else's household expenses. Only 24 men were entirely responsible for the upkeep of their households. One man was in receipt of National Assistance of

1s. 6d. a week, but, with this exception, the group of men surveyed did not appear to be suffering any real economic hardship. One or two of them appeared to be seriously worried about their financial position, but as many as 36 said that they had not found it necessary to economise in any way since they had retired. A number of them, however, qualified their statements by pointing out that the situation would be different if they were not working or if their children left home.

The main economies of those who had been forced to limit their expenditure were made on household replacements, clothing, entertainments, beer and cigarettes. 11 men mentioned that they had had to cut down their expenditure on certain types of expensive food, meat and cakes in particular, and a few said that they could no longer afford bus fares as often as they would like. Economies on smoking and visits to the public house were those felt most keenly by these men.

It is obvious that many of the men interviewed have not yet felt the full financial impact of retirement, for they still have children at home who are helping to maintain the household. If, and when, their children leave home the position will be very different. It is possible that then they may be anxious to work again, but by that time they will be older and less likely to obtain employment or to adjust themselves satisfactorily to it.

Increasing infirmity with its consequent restriction on mobility is one of the greatest trials of retirement, and necessarily affects a man's willingness and ability both to go out to work and to maintain his social contacts and other interests outside the home. An attempt was made to obtain some information on these points but it must be emphasised that the investigator had not the medical qualifications necessary for a scientific assessment of the health of the group of men interviewed, and what follows, therefore, is purely a subjective and descriptive account depending largely upon what the men stated about their condition.

33 of the group of 74 were either known to have had chronic physical disabilities at the time of their retirement or said that they had become disabled since. Their main complaints were bronchitis, heart complaints and diseases of the bones and joints. A further six men suffered from minor disabilities such as deafness, or complained of feeling unwell without mentioning any specific ailment. It thus appears that approximately half the group had some form of physical limitation, although it appeared that only 20 were undergoing medical treatment.

The suggestion is sometimes made[1] that continued employment is conducive to the maintenance of good health in elderly persons and retirement may lead to physical deterioration. Only 10 men in this group said that their general health had deteriorated, however, and 36, among whom were 17 with disabilities, said that their health had improved. This was attributed to more rest, fresh air and exercise since retirement, and being away from the conditions of factory life. For example, one man who claimed that his health had improved said he put it down to "taking life more easily and having no responsibility"; and continued, "We had to keep up to the pace of the machine in the factory and towards the end it became a bit much; so did the shifts". Another commented, "I used to have bronchitis, but I'm much better now that I'm not working in the dust, not having to get up early and not having to go out in the winter if I don't want to". Of the 10 men who said that their physical condition had deteriorated, half attributed this to the fact that their chronic disabilities were getting progressively worse, the other five complained of feeling generally ill and tired. Four men suggested that retirement allowed them more time to think and worry about their complaints. Although there were a few men who were severely handicapped no one in the group was confined to the house; 59 went out frequently, 7 only when they had a specific reason for doing so, and 8 disabled men only managed to go out occasionally in the summer months. In this connection, it appeared that, apart from the disabled, the men who went out least were those who had retired during the winter months and had not established a routine of going out regularly immediately after retirement.

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[1] For example, by J. H. Sheldon, in *The Social Medicine of Old Age*, Nuffield Foundation, 1947, pp. 192-3.

When regular work comes to an end, leisure activities are increasingly important in helping to fill the gap caused by retirement. Outdoor activities, such as gardening for those who lived on the new estates, walking, football matches and bowls were the chief interests of this group of men. Well over half the group mentioned walking, sometimes quite aimlessly, as their main activity. They usually went alone; comparatively few wives accompanied their husbands except on special occasions.

Apart from those who had been on the staff, few of the men interviewed had any indoor hobby or interest, and if unable or unwilling to go out, they had little with which they could occupy their spare time and became bored and depressed about their retirement. Very few of them had established a habit of reading anything except newspapers and periodicals. Only 15 of this group of 74 men belonged to a club; 7 of them were members of clubs exclusively for old people and 8 belonged to Community Clubs, Church clubs, etc., admitting people of all ages. Of those who did not belong to a club, only 5 expressed a wish to join one. The remaining 54 had little knowledge of the clubs for elderly people in their area and showed no desire to join one. They said that the clubs were too big and that it would be difficult to get to know the members. Some were unwilling to associate themselves with organisations specifically for older people. It was clearly evident from the survey, however, that the public house plays a very important part in the social life of elderly men. It is in fact their club, for there they meet their friends and join in communal activities such as darts and bowls.

With a few exceptions the men in the group had little contact with their former workmates and fellow pensioners. Sometimes they met by chance, but visiting and entertaining did not appear to be customary among this group except among relatives, and only two of the men interviewed said that they visited or were visited by other pensioners in their own homes.

Many of them paid occasional visits to the factory to see their former workmates, but they said they felt 'in the way' and that they were holding up the work of the department. However, although their contact with the factory is very limited, the majority of the men gave the interviewer the impression that their identification with the firm is very close. Even those who had found work elsewhere felt that they were still part of the firm and that the management, and in particular the older directors, took a personal interest in them as individuals and not merely as retired employees. In their turn these men evinced real personal affection and respect for the members of the family at the head of the organisation.

In their treatment of pensioners the firm was generally considered by the men to compare favourably with others in the area. In addition to the pensions, small things such as the annual reunion and receipt of the works magazine were greatly appreciated and the long service awards are treasured possessions. The firm's policy of retirement was accepted by the majority of them as inevitable in view of the nature of the work; so was the fact that there were younger disabled men who needed the lighter jobs on which older workers might otherwise be employed. Many of them also expressed approval of a retirement policy which treated all employees alike from directors downwards. The indications would appear to be that although compulsory retirement at 65 has many disadvantages it does prevent feelings of anxiety and inferiority on the part of those who under a system of selective retirement might be considered unsuitable for continued employment.

CONCLUSIONS

Conditions in this firm and the nature of the group investigated present certain special features, but it is possible, in conclusion, to draw attention to the resemblance between the findings of this local survey and those of more extensive investigations.

In the first place, the study of the records of the men in this group made it clear that ageing is a gradual process, and that firms must be prepared to make adjustments for unskilled and semi-skilled workers doing heavy and medium-heavy work as they grow older. These adjustments may take the form of transfer to lighter jobs, or of lessening the pressure of work in the worker's existing occupation, or of a changeover from shift to day work, this last change being the one to which the men appeared to attach the greatest importance. As the number of workers passing from the younger into the older age groups increases, as it is bound to do during the next few years,[1] the making of these adjustments may become increasingly difficult unless carefully planned. A necessary feature of such plans would seem to be careful job analyses in each industry with the diminishing capacities of older workers in mind. The problem of the change from shift to day work would appear to be a particularly difficult one, but in view of the physical strains and family and social deprivations which shift work entails, it would seem to merit special consideration.

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[1] By 1962 the population between the ages 20-40 is expected to be less by nearly 7% than in 1952: the numbers between 50 and 60 are expected to increase by about 17%. See the First Report of the National Advisory Committee on the Employment of Older Men & Women, p.9.

It will be recalled that the majority of the men covered by this investigation who said that they wished to retire at 65 gave infirmity or ill-health as the reason, and the impression was obtained that many such men were suffering from general malaise and strain rather than specific disabilities. This observation may be compared with the findings of the much more extensive inquiry made by the Ministry of Pensions and National Insurance, in which 25.2% of the men taking the retirement pension at the minimum age gave 'chronic illness' as the reason, 24.8% ill-health and a further 3·6% 'heaviness or strain of work'. Many men appear to feel as they grow older that the continued strain of the work is becoming too much for their waning powers and they are beginning to wear out. This is not perhaps surprising, as the unskilled and semi-skilled workers now reaching retiring age grew up in families where primary poverty was still rife and the benefits of the welfare state unknown; they left school to start work at 12 or 13 and at a time when hours were longer than they are now; they have lived through two wars and the years of industrial depression. Much physical and psychological damage has probably already been done by the time the man of this generation reaches later middle age. Nevertheless, healthier and easier working conditions and careful medical supervision including rehabilitation after those minor illnesses and injuries, which has already been noted, may act as 'trigger factors', making a man fully conscious of the strain to which he is subject, may, even at this stage in his working life, combine to combat the onset and further progress of this deterioration.

In considering the reasons which led 63% of the group of men studied to say that they would like to continue working as long as they were able, account must be taken of the fear evidently felt by the majority of them that financial hardship would result from their retirement. In this respect the opinions of the Liverpool group, 55% of whom thought that the combined State and works pensions would be insufficient to ensure a reasonable standard of life, and another 16% of whom were uncertain as to whether their income on retirement would be sufficient or not, may be compared with those contacted by the Ministry of Pensions, for in their survey 44·7% (the largest single group) of the 7,175 men who were taken as representative of those who stayed at work said they did so for financial reasons. As with the Ministry of Pensions survey it appeared to be the extra income at the time rather than the prospect of a larger pension later that was the major inducement to continued work. A few appeared to be envisaging the possibility that they might be bored or lonely after their retirement, but for the majority realisation of this came with the experience itself.

Answers given to the questionnaire sent round before retirement, and information given to the investigator when she visited those who had retired, revealed that the majority of these elderly men were unwilling to face the anxieties and adjustments that work in different surroundings and with a different firm would involve. They were prepared to continue an already established routine in known conditions and working with and for people to whom they have been accustomed, or to retire to the familiarity and security of home and neighbourhood but not, except perhaps as a last resort, to make the effort of finding and accepting a new job with all the strains and adjustments this would involve. They evidently wished to relax both physically and psychologically, and so those who asked for work asked for light work with no time stress and in familiar surroundings. Several of the Liverpool men studied said that they liked the social stimulus and interest of working in mixed groups with younger men, but were only prepared to do this if they were not expected to keep pace with these men. That it is the pace of the work rather than the number of hours worked that is felt generally to be a strain is indicated by the fact that, with few exceptions, the men were prepared to work normal hours all the year round, but as might have been expected from the unpopularity of this form of work among elderly employees, they were not prepared to tackle or to continue shift work.

The principal reason for undertaking the 'follow-up' survey was to discover whether the actual experience of retirement resulted in any marked change in attitude. In fact, the most noticeable characteristic revealed by the group of men interviewed after their retirement was their rather passive acceptance of their new way of life. Before retirement they accepted the work situation and wanted to continue in it as long as they felt physically able to stand the strain: after retirement they settled down more or less contentedly. It is true that 34 of the 62 men who were not working said they wanted work, but only 14 had made any attempt to find it, and as substantially the same results were obtained in an investigation made by Thomas and Osborne for the Social Survey,[1] this may be a fairly common pattern of behaviour. At least for those who can claim a works as well as a State pension the early years of retirement do not appear to be years of great financial hardship as earning sons and daughters are still living at home, and, once having broken with their work, its associations and routine, the majority are satisfied, unless driven by necessity, to settle down to what they regard, with some justification, as a well-earned rest. In a significant number of cases in the Liverpool survey this reluctance to break the routine of retirement once it had been established appears to have been reinforced by chronic ill-health which would make the return to work difficult if not impossible, while 10% of the subjects of this survey and 6% in the study made by Thomas and Osborne had home commitments. With very few exceptions, when once a man retired from his own regular work with his own firm he would seem to be lost to industry.

The question as to what a man does with the leisure retirement brings is hardly central to this study, but it is perhaps worthwhile noting that the results of the enquiries made by this investigation tallied with the relevant particulars of the findings of other surveys into the circumstances of old people, in spite of the fact that these usually included a large proportion of really old persons in their samples, while the oldest men in this group were still under 68 at the time of the survey. In this, as in an earlier survey made in Liverpool by the same Department,[1] it was found that family ties were generally strong and durable. Ties of neighbourhood, interest, friendship and common employment appear to be weak in comparison, and it is symptomatic of the lack of interests and purpose in the lives of many retired persons that several of the men interviewed spent much of their time wandering aimlessly about the city to pass the time away. The clubs which have been started for the benefit of elderly persons appear to attract a very small proportion of them, and the only social institution which played any significant part in the lives of the men in the sample was the public house. Professor R. Titmuss has remarked in another connection, " for more and more people work and death are becoming increasingly separated by a functionless interregnum ", and the purposelessness and passivity which already characterised the lives of these men so recently retired is a poor augury for their remaining years. Further consideration of this topic is outside the scope of this article, which is concerned with the transition from work to retirement, but, to complete the quotation from Professor Titmuss, " What is the individual and society to make of this enlarging span of twelve or fifteen surplus years? "

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[1] See Geoffrey Thomas & Barbara Osborne, *Older Persons and their Employment;* and the Social Survey Reports 150/1 and 150/2, 1945, Part I, Section III. 37% of the men interviewed on this point said that they were willing to return to work given the opportunity but less than half of these had tried to obtain it.

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[1] See *Social Contacts in Old Age*, University Press of Liverpool, 1953.

Age Structure in the Engineering Industry: A Preliminary Study

By K. F. H. MURRELL, S. GRIEW and W. A. TUCKER

INTRODUCTION

ALTHOUGH in recent years much laboratory work has been undertaken to isolate and identify changes in skill with age (for example, Welford *et al*, 1951; Welford, 1956; and Birren, 1955), remarkably little has been done to assess the importance of these changes in industry. Except in certain instances such as the study of work with time stress (Belbin, 1953), and the study of heavy work (Richardson, 1953), questions such as "Do men, as they get older, find it increasingly difficult to continue working on some jobs with optimum efficiency?", and "Are there some jobs which are avoided by older men?", remain largely unanswered. In fact, industrialists, if asked, will usually deny that they have any age problems at all, except perhaps that of finding 'easy' jobs for men past retiring age. This problem also has received attention in recent years (Le Gros Clark and Dunne, 1955; and Le Gros Clark, 1956).

The Unit for Research on Employment of Older Workers, attached to the Department of Psychology, University of Bristol, is interested primarily in the identification of ageing effects in industry, in assessing their probable causes and, ultimately, in suggesting ways of minimising them.

At the start of our investigations a search was made for information on the age structure of any industry broken down into individual trades, but none could be found. We decided, therefore, that we would have to do this ourselves in order to see if there were any occupations which were deficient in or had an excess of older workers. 'Older workers' were defined as those between 45 and 64 years of age, that is, those in the latter part of their working life. If such occupations existed, and causes other than age could reasonably be eliminated, an analytical study might reveal some of the reasons for the age differences.

Light engineering was selected for study because it is one of the major manufacturing industries. It covers a wide range of trades involving exercise of varying degrees of skill, and a high proportion of the employees are males. The study was confined to males as the employment of women is influenced by many social factors which cannot be assessed.

An approach was made to a number of firms who kindly provided us with facilities for obtaining information about the age, occupations and length of service of all male employees on the shop floor. This was analysed and it was found that in all firms there were age differences associated with various jobs.

The next question was whether these differences were peculiar to the time of the study, or whether they had persisted over a period of years, and were, in consequence, more likely to be real than historical. To answer this, we selected Firm A for more detailed analysis, and reconstructed the pay-roll as it was on 1 January, 1947, and made a study of the changes which had taken place between then and 1 January, 1955. We found, in general, that the age differences between jobs in 1955 were present also in 1947.

The present report presents the information so far obtained. It deals first with the age structure of a number of companies broken down into main trades, and with age changes which have taken place in Firm A between 1947 and 1955. Later, some incidental results will be discussed, and one or two applications of the findings will be suggested.

The normal adult working life of a man ranges from 21 to 64 years of age. Most conventional age breakdowns employ five- or ten-year groups which must include either, at one end, the 20 year olds, many of whom may be apprentices, or, at the other, the 65 year olds, many of whom may have retired. In either event one or other of the groups will be an artifact of one of its component years. Since the adult working life covers 44 years it is convenient to divide this into four-year groups, and this system has been adopted throughout the present work.

The principal analyses have disregarded the under-21 age group. This is because the group includes a very large number of apprentices, the inclusion of which may lead to some confusion. In the first place, it is extremely difficult to stipulate the precise job upon which an apprentice is at any time engaged. They change their jobs fairly frequently and their placement in the factory may depend on factors of demand to a much greater extent than with adults. Secondly, they cannot be regarded as fully productive workers for the reason that their activities are very largely training. Thirdly, they may spend much of their time in Apprentice Schools, away from the workshops.

A suitable measure of the 'age' of an occupation was difficult to choose. Discussion of the relative merits of such measures as Mean Age, Median Age, Proportion over a certain age and Mean Age of the upper half (a measure used with success by Welford and his colleagues in their industrial surveys; see Welford *et al,* 1951) led us inevitably to the task of trying each in turn. It was found that similar results were obtained with each measure. The eventual decision to use Median Ages was governed by a wish to avoid, as far as possible, the curious effects of the few individuals whose ages lay well outside the range of the majority in any distribution. The occasional men of 72 in a 'young' job, and the rare men of 24 in an 'old' job, could sometimes have produced Mean Ages which would not truly have reflected the characteristic 'age' of the job. These exceptions are of obvious importance and a separate investigation of them, to be undertaken at a later stage, is envisaged. It is interesting to note that, in using Median Ages, the absolute values of such statistics as correlation coefficients were slightly lower than those obtained when Mean ages or Proportions were used. Similar levels of significance were obtained, however, in all cases.*

*Since this study was completed a method of calculating the 'characteristic age of the job' has been devised. This involves taking into account the available labour force. The method will be described shortly elsewhere.

THE AGE STRUCTURE OF COMPANIES IN 1955

We started our enquiry by making an analysis of the age structure of jobs in Firm A. When we had completed this work we found that the median ages of men on various jobs ranged between 31 and 58 years, and that in general the machinists were younger than those in the relatively less skilled jobs such as Storekeeping or Plating and Heat Treatment. The choice of Firm A was influenced by the high standard of workmanship demanded, the general absence of pressure to produce large quantities at high speeds and of repetitive work of the assembly line type. Being large, it seemed to be somewhat impersonal and without the type of loyalties found in small 'family businesses'. There is no compulsory retirement associated with a pension scheme: men are kept so long as they can work productively, and are engaged on much the same basis at any age. There is, moreover, a big demand for engineering labour in the district in which the firm is situated, so men do not stay simply because they cannot get work elsewhere.

When we made this analysis we were then faced with the question of whether Firm A was unique or representative of other engineering firms in the South-West of England. Were there firms to which the older machinists had moved and which would therefore have higher median ages for these skilled trades? In an attempt to answer these points we obtained the co-operation of several other companies in Gloucestershire, Wiltshire and Worcestershire. They were all engaged in engineering, but their products and their organisation were very different.

Firm A, as has already been said, was a component of a larger group engaged in the manufacture of internal combustion engines of very high quality. It employs over 3,000 men and is rather impersonal, the top management being quite remote from the individual on the shop floor.

Firm B is also large with about 2,500 employees. The top management is in London and has little contact with the shops, and the local management is 'patriachial'. Its products are varied and are not of quite such precision as those of Firm A. It is the only engineering concern in the town in which it is located and so does not perhaps have the same competition for its labour.

Firm C has about 850 employees. It is a young company which has expanded rapidly. It is engaged mainly on making prototypes, the actual manufacture being largely by sub-contractors. When it was smaller there was personal contact between top management and the shops, and older men can remember this but the younger men do not feel the same 'personal touch'.

Firm D has about 320 employees. It is a family business with the present Managing Director a member of the family, who knows all his employees personally. The products are largely only a few off, and the quality is normal for this type of business.

Firm E has about 600 employees. It is engaged in manufacturing motor vehicles, engines and chassis, on a relatively small scale. It is an old established business which is now part of a much larger organisation.

Firm F has about 450 employees. It is an old established firm which now forms part of a group of companies, sharing directors, but otherwise retaining its identity. Many of its products are one or two off to customers' requirements.

Firm G manufactures motor vehicles on a large scale by mass production. It has relatively few of the trades found elsewhere and these are concentrated in two departments, which were the only ones whose records we analysed. They contained in all about 1,500 men.

TABLE 1: MEDIAN AGES OF MEN ON VARIOUS JOBS 1955

JOB	FIRM A	FIRM B	FIRM C	FIRM D	FIRM E	FIRM F	FIRM G
Pattern Makers	31.50	41.83	—	28.50	37.00	27.00	—
Electricians	35.28	31.63	42.75	33.50	35.70	35.00	43.00
Millers	35.44	35.40	35.13	34.63	43.40	34.75	40.70
Grinders	37.50	40.50	35.50	39.50	40.00	35.00	42.60
Turners	37.90	38.25	34.83	49.50	44.00	48.00	47.50
Borers	38.00	41.88	34.00	40.05	36.50	47.00	55.00
Sheet Metal Workers	39.00	37.50	—	36.50	42.75	—	48.00
Testers	39.80	38.94	35.50	—	39.00	—	43.00
Drivers	42.25	43.25	40.75	35.50	38.00	—	—
Drillers	42.80	40.88	41.50	43.75	43.00	49.67	—
Inspectors	43.60	43.25	42.10	52.75	55.22	—	60.95
Polishers	43.70	47.50	39.63	—	48.50	—	—
Welders	44.50	44.50	—	40.75	—	41.75	39.00
Fitters	44.91	39.83	41.75	45.75	35.57	37.50	35.13
Foundry Workers	45.00	38.57	—	40.50	—	53.40	—
Building Maintenance	46.60	45.30	39.13	45.75	—	—	—
Plating and Heat Treatment	48.83	44.50	48.50	—	—	42.00	—
Storekeepers	52.22	49.33	47.88	41.50	48.92	57.17	50.43
Factory Services	56.83	54.80	52.75	61.50	—	—	—
Labourers	57.12	53.43	51.88	51.13	58.11	58.27	59.00
Packers	58.25	50.04	49.75	54.50	—	52.50	—

Table 1 gives the median ages of men employed on jobs which were common to at least four of the companies, that is, common in name. We were unable to visit every firm and make analyses of the exact nature of the work being done, so we were compelled to assume that men described as being of the same trade were doing approximately the same kind of work. We were quite well aware that men described as Borers, for instance, would be doing rather different work on jigborers to those on universal borers, and that Fitters do a wide variety of jobs. To have done other than what we did, however, would have taken so long that the work might not have been finished for years. We took the precaution of excluding from this analysis jobs involving only a small number of workers, in order to reduce the rate of the possible objection to the method based upon the range of ages generating, in each case, the recorded medians.

As it is, the differences which may exist in the different firms in the conditions and working methods of men who have nominally the same job will make, we think, all the more remarkable the agreement which, with some exceptions, exists between the median ages of men of the same nominal trade, by different firms. For instance, the median age of Millers is 35·4 years, 35·4 years, 35·1 years and 34·6 years in Firms A to D, and

34.8 years in Firm F. We have used Kendall's ranking method (Kendall, 1948) as a measure of agreement between rankings of jobs by age in the different firms, and these data are given in Table 2. It will be noted that only eight correlations in this matrix are non-significant, and that of these four are associated with Firm G.

TABLE 2: RANK ORDER CORRELATION COEFFICIENTS BETWEEN FIRMS, FROM DATA IN TABLE 1

	FIRM A	FIRM B	FIRM C	FIRM D	FIRM E	FIRM F	FIRM G
Firm A	—						
Firm B	.612***	—					
Firm C	.569**	.489**	—				
Firm D	.630***	.444*	.398*	—			
Firm E	.371*	.325	.245	.436*	—		
Firm F	.641**	.389*	.404	.581**	.449	—	
Firm G	.229	.229	.023	.309	.509*	.563*	—

*** indicates $P < .001$, ** $P < .01$, and * $P < .06$

Firm G differs from the rest of the firms in that it is the only one operating mass production and whereas the term Turner, Miller, Grinder, etc., usually applies to a man who puts a part in his machine and uses his skill to process it, in Firm G the machines are mainly automatic or semi-automatic, and men working them are, for the most part, ' minding ' them. This suggests that even under the different working conditions in the various firms, and the different type of machine operated, men of the same trade are roughly of similar age, but when demands become rather different, as they are in Firm G, then there is little or no similarity in age. The results also suggest that the age structure of Firm A is not unique.

Although these results suggest that there is something about some jobs which makes them unattractive to older men it does not tell us what is happening to men in these trades as they get older. If they leave this type of work, as it seems they must, where do they go and what sort of work do they do? Without doing an analysis of every engineering firm in our area it would be impossible to say with certainty that they do not move in the same trade to some other shop. But on the evidence of the firms we have selected as being very dis-similar in organisation and product it seems that they may be moving into other work. Obviously, if the median age of Millers is consistently about eight years below that of the whole working population, then it seems quite likely that many must cease to be Millers in their forties and fifties.

A study of internal migration in Firm A provided some information about transfer from ' young ' jobs. This is mentioned later. Interviews with a cross-section of older leavers are in progress and results will be reported separately. As has already been mentioned, there are some instances where the median age of a job in one firm differs widely from that in the other firms. These ' exceptions ' are Pattern Makers in Firm B, Electricians in Firm C, Inspectors in Firm D and Millers in Firm E, etc. Without examining the work in detail we cannot suggest reasons for this, but when all possibilities are considered it is perhaps remarkable that there are not more deviations, and that they make so little difference to the significant correlations of the rankings.

FIRM A: 1947-1955

We have seen that in January, 1955, there were differences between the median ages of men in Firm A on different jobs. As has been mentioned already, these differences may have been due to a variety of causes, some real and some historical, of which the following would seem to be the most important:

(a) difficulties due to age;
(b) deliberate engagement or dismissal policy on the part of the firm;
(c) deliberate placement policy on the part of the firm;
(d) social causes, e.g., housing difficulties;
(e) past educational opportunities;
(f) opportunities of moving to other work;
(g) technological changes.

These causes may, of course, act together or independently.

It was almost impossible to come to any conclusion on these points without knowing something of the past and so it was decided to reconstruct the payroll as it was at 1 January, 1947, in order to see whether the position at that date was similar to that at 1 January, 1955. The choice of 1947 was something of a compromise. The immediate post-war period was one of upheaval and change, and demobilisation was in progress. Ideally, a time chosen for comparison should be after things had settled down. On the other hand, too short an interval between the dates would reduce the value of the information which could be adduced. By 1947, the firm told us, most of the post-war reorganisation was completed. There were still 436 men in the Forces, compared with 94 in 1955, but eight years seemed the shortest useful period for study.

The method used was to go through the register of those who had left and to note those men who had been employed in the firm on 1 January, 1947. These were termed the *Leavers*. Abstracting from the payroll in 1955 all those men (the *Intake*) who joined after January, 1947, we had a residue of men who were in employment throughout the eight years, from January, 1947 to January, 1955. This group was called the *Stayers*. The Stayers and Leavers together form the 1947 payroll.

It will be noted that no record was made of those who joined after 1 January, 1947, and who stayed less than eight years. This was for two reasons. First, we felt that the work involved would not produce commensurate results, and secondly, and more important, the 1947 population is a cross-section or sample of the company at a given point in time. The length of service structure of the company does not seem to have changed since that date and so by analysing the 1947 men who left the company in the following eight years relationships have been obtained which were

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unbiassed by men with short service, who tend to belong to the younger age groups. We believe that this method gives a clearer picture of such relationships as age and length of service than that commonly used of keeping 'running records' over a period of time which must contain a preponderance of men with short service. The register contained the occupation of each man when he left, and also assigned a cause of leaving, but did not give the occupation in 1947. Since we needed to know this it was necessary to get the information from such documents as had been preserved. In some cases this was difficult but there was invariably some clue which enabled us to infer what actually he was doing at the time. Similarly, we had to go through the records of the Stayers, to find out how they were employed in 1947. Altogether we examined the records of some 4,500 men: about 150 were missing or incomplete and these we assumed to have been in the same occupation in 1947 as they were upon leaving or in 1955.

From all the occupations represented we selected twenty-one as being worthy of special analysis. The twenty-one jobs accounted together for 3,141 men out of 3,430 in 1947, and for 3,140 out of 3,468 in 1955. The remainder of about 300 in each case were distributed over about 30 trades, the only group of any size being the Drivers. Although there were 58 of these in 1955, they were not included because many of them were employed outside the factory. In making this analysis we omitted from the 1947 figures those who were in the Forces or who were Apprentices, and who left the firm before 1955.

Age Distribution of the British Working Population

Before making an assessment of the age changes in Firm A between 1947 and 1955, it was desirable to know what age changes there were in the National working population over the same period. The only data of which the Ministry of Labour and National Service could tell us were:

(a) those obtained by a count by the Ministry of National Insurance of insurance accounts of all employees at the end of May, 1950, and the end of May, 1954. These were based on a 1% sample, and persons working on their own account and men in the Forces were excluded;

(b) the 1931 census;

(c) the 1951 census (again based on a 1% sample).

The May, 1954 figures are probably near enough to January, 1955, to be used as a basis for comparison, but nothing seemed to be available for 1947. Counts taken in 1948 and in earlier years, before the 1948 National Insurance Acts came into force, are not comparable because they exclude all those who were outside the scope of the unemployment insurance scheme.

We computed, therefore, a distribution based on the distributions of the male population in 1947, 1950 and 1954, and the proportions of each age group employed in 1950 and 1954. These proportions remained remarkably constant between 1950 and 1954 and have been assumed to have been the same in 1947.

In comparing these distributions with each other and with Firm A it is essential to bear in mind that the methods used to obtain them will be subject to sampling errors. The two curves are given in Figure 1, and it will be seen that they differ somewhat. Up to 32 years, and from 48 to 56 years, the 1947 curve is lower. In 1947, 1,361,000 men were in the Forces, compared with 816,000 men in 1955, and the majority of these would have been under 32 years of age. In addition, in 1947, the 29 to 32 age group corresponded with the period of low birth-rate in the 1914-1918 war, which also accounts for the dip at 33 to 36 and 37 to 40 in the 1955 curve (the three low ages are 35, 36 and 37 years). The three years following the 1914-1918 war had a high birth-rate, and this also shows in the 1955 curve. The deficiency in 1947 between the ages of 48 and 56 is due probably to the casualties in the first world war; in the total male population there were 552,000 less men in 1947 than in 1955 between the ages of 45 and 54 years.

Over the eight years covered by our survey the Mean Age of the working population increased by 0.39 years, from 42.44 years to 42.83 years, and the percentage of men over 44 years of age from 39.7% to 42.5%. It should be remembered when comparing 1947 figures with 1955 figures, that there were 545,000 more young men in the Forces in 1947 than in 1955. Had there been approximately the same number of men in the Forces in 1947 as there were in 1955, then the Mean Age in 1947 would have been 41.8 years, and the percentage over 44 years 38.1%. The increase in Mean Age would then have been 1.03 years.

FIGURE 1

AGE DISTRIBUTION OF THE BRITISH WORKING POPULATION

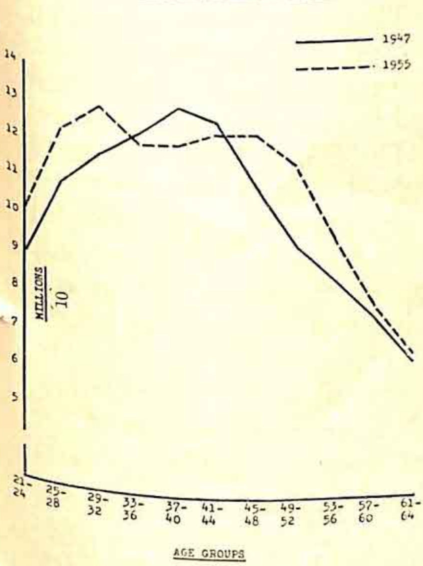
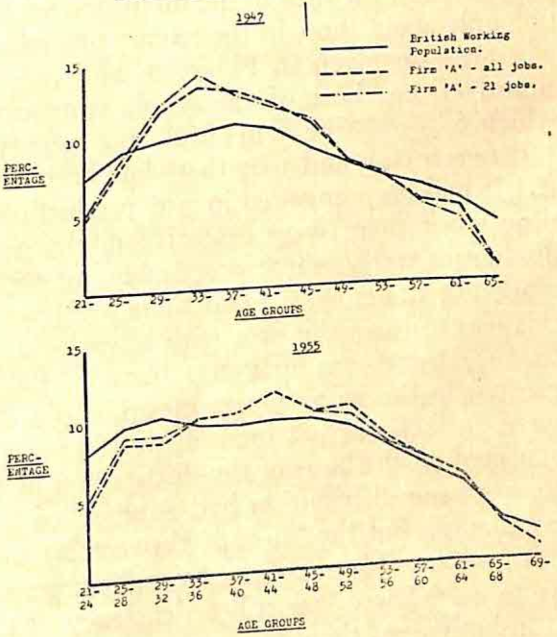


FIGURE 2

AGE DISTRIBUTIONS OF FIRM 'A' 1947 AND 1955



General Age Changes in Firm A

TABLE 3: AGE CHANGES IN NATIONAL WORKING POPULATION AND FIRM A BETWEEN 1947 AND 1955

	1947		1955	
	FIRM A	WORKING POPULATION	FIRM A	WORKING POPULATION
Number of men over 20	3,439	12,038,000	3,458	12,570,000
Number of men in Forces (all ages)	436	1,361,000	94	816,000
Percentage of men in Forces	12.5	11.5	2.7	6.5
Mean Age	41.59	42.44	43.41	42.83
Median Age	40.54	41.47	42.73	42.02
Percentage of men over 44	36.5	39.7	44.7	42.5
Percentage of men between 45 and 60	30.9	30.7	35.9	32.8
Percentage of men over 60	5.6	9.0	8.8	9.7

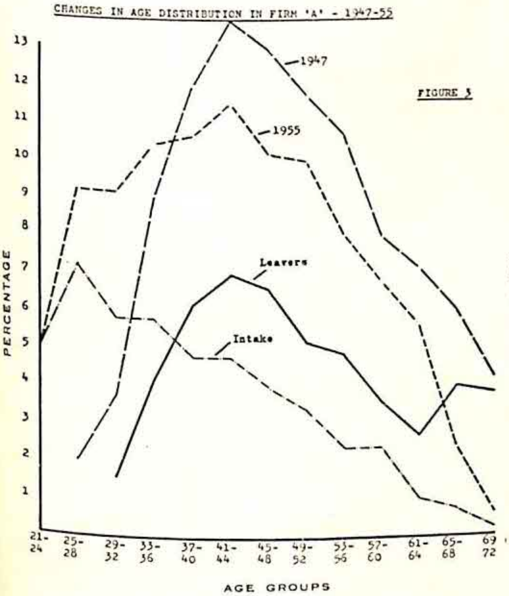
The main data relating to 1947 and 1955 are given in Table 3 and graphs comparing age distributions in 1947 and 1955 with their respective population curves are given in Figure 2.

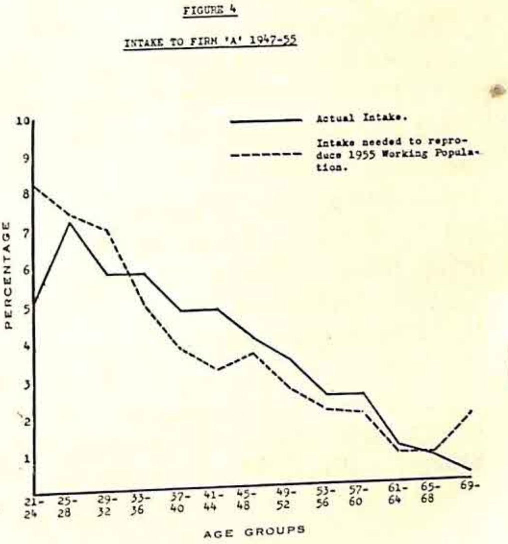
While it is probably correct technically to use the whole of the male population of the firm in the discussion which follows, we have full information only about those in the twenty-one jobs. The curves for the twenty-one jobs are also given in Figure 2, and it will be seen that they differ very slightly from those of the whole company. Therefore, in the discussion which follows, 'the firm' and 'the twenty-one jobs' will be synonymous.

Between 1945 and 1947 there had been widespread reorganisation in Firm A. It had been engaged in war production and in changing over to peace-time work there were extensive discharges. The firm tells us that these discharges were, where practicable, on the basis of 'last-in, first-out'. As work got under way again there were some engagements. The effect of this was to leave the firm with a work-force very much on the young side. In 1947 there was an excess between the ages of 29 and 48, which was greatest in the 33 to 36 age group, and a deficiency of men over 57: there were, in fact, only 23 men of over 64 years of age, instead of the 123 to be expected on the basis of the distribution of the general working population. By 1955 the distribution had approached much more nearly to that of the population, but the 'hump' between 29 and 48 years was still in evidence, but now moved, of course, by eight years with the peak now at age group 41 to 44. There was still a deficiency of the very oldest workers.

In both years there was a very marked shortage in the 21 to 24 age group which seems likely to have been due to the incidence of National Service. In a firm such as Firm A, the majority of young males are apprentices who start their National Service at the age of 21, and this would account for the deficiency. In fact, in the 21 to 24 age group, 168 men were away in 1947, when the deficiency was 118, and 94 in 1955, when the deficiency was 100. It must be borne in mind, however, that the national figures also include apprentices doing their National Service, but these do not amount to more than about 10% of those aged 21 to 24 years. On the other hand, more than 50% of this group were away from Firm A in 1947, and 35% in 1955.

The nature of the changes over eight years are shown in Figure 3. For each age group are given the percentage employed in 1947, the Leavers and the Intake, to give the 1955 distribution. Up to retiring age the Leavers' curve is nearly proportional to the 1947 curve, while from 25 years the Intake falls off almost linearly. As a result the peak present in 1947 has not disappeared by 1955, as has already been noticed. The Intake curve as it should have been to have made the 1955 curve agree with the National distribution is shown in Figure 4, and shows that more men were engaged from 35 years to retiring age than were needed to make the firm typical.





We find that the age distributions for 1947 and 1955 differ significantly ($\chi^2 = 379.1$, $P < .001$). Moreover only 1,122 men (35.5%) were doing the same jobs in 1955 as they were in 1947, 528 (15.8%) were still in the firm but doing other work, and 1,697 (50.7%) had left. Thus the make-up of the firm in 1955 was very different from what it was in 1947. This is a very important finding to which we shall refer again later.

Changes in the Twenty-One Jobs over Eight Years

As has already been stated, twenty-one jobs were analysed in detail. Seven of these fall under the general description of machinist (Borers, Capstan Operators, Drillers, Grinders, Millers, Profilers and Turners), most of those engaged in these occupations were on productive work, while others were engaged in the Tool Room. The Fitters cover a wide variety of actual jobs, but it was quite impossible to separate them in 1947 although this has been done for 1955. Pattern Makers, Inspectors, Testers, Setters, Electricians, Storekeepers, Labourers, Polishers and Instrument Makers are all fairly specific occupations, but the 'Foundry' and 'Plating and Heat Treatment' are departmental descriptions in which every one working except Labourers is included. Under 'Factory Services' are put such jobs as Lavatory Attendant, Beltman, Oiler and so on.

For each of the twenty-one jobs we traced what happened to men who were employed in 1947. Those who left an occupation:

(a) could have been transferred to the staff or to another firm in the group, and we did not trace the subsequent history of these;
(b) could have been dismissed for misconduct, as unsuitable or redundant;
(c) could have died, retired or left because of illness;
(d) could have transferred to other work (within the firm);
(e) could have left voluntarily.

All the machinist trades have increased in number, and so have most of the trades which handle their products, except Fitters who are down to about 70% of their 1947 numbers. This is likely to be due to a change in the nature of the products; larger units needing more parts per unit are now being made. This could also account for the big drop in the number of Testers, and the somewhat smaller drop in the number of Labourers. These losses have just about balanced the gains so that there is a difference of only one between the totals present in 1947 and 1955.

There are, in the twenty-one jobs, two which are non-conforming. They are Capstan Operators and (machine) Setters, and both are subject to deliberate policy. The Capstans are treated as a training ground for young semi-skilled machinists (there are also a number of women), and as a result the turnover is high, no less than two-thirds being moved to other work, compared with one-sixth of those on other jobs, while only one-sixteenth of those on capstans in 1955 were there in 1947.

Men called Setters are to some extent misnamed. They work in the machine shops. Many machinists do their own setting under the supervision of their setters who are also responsible for allocating work to the machine. They are, in fact, a kind of chargehand and act as such. The Setters undergo an extensive training before taking on their duties and they have a high expectancy of promotion and/or transfer, about three times as great as have other trades. Unless specifically stated, these two jobs will be excluded from any generalisations which follow.

The machinists have, with the fitters, a lower survival rate—that is, continuing in the same trade for eight years—than most of the other trades, with 41% or less Stayers. Their dismissal rate is low, 7.4% (15%)*; their voluntary leaving rate is high, 23% (17.4%). A relatively small number were promoted or transferred, 4.1% (8.4%); but a large number, 27% (13.8%), were transferred to other work. As most of the Setters who came

*Figures in brackets in this paragraph refer to the average of all the remaining jobs. Employing appropriate statistical tests, differences referred to were found all to be significant at the 5% level at least.

from other jobs were machinists, this high number can be accounted for, and also accounts for the small number of direct promotions or transfers.

The relatively low number of Fitters who stayed is partly accounted for by the run down in numbers of about 30%. With the skilled men this has been achieved by transferring and dismissing slightly more than the average and taking on quite a lot less. With the semi-skilled Fitters there has been almost a clean sweep; dismissals, moves to other work and voluntary leaving are all high. As a result, the intake is also high, but not so high as would have been the case if the number of semi-skilled Fitters had remained constant.

Of the remaining eleven jobs which are auxiliary to the main production, all but four have a Stayers' rate of more than 45%. Points of interest amongst these jobs are the very low number of voluntary leavers in Plating and Heat Treatment, 3.2%, coupled with a higher than average death rate, 10.5%; the relatively large number of Inspectors moved from other work, 25%, and the small number moved to other work, 3.3%.

The four auxiliary jobs with less than 45% Stayers are the Testers, Storekeepers, Factory Services and Labourers. The Testers were the most heavily run down of all the twenty-one jobs, to only just over 25% of their 1947 strength. This has been achieved by moving, transferring and dismissing, equally, about 50% more than the average. The remaining three jobs have this in common. They alone have mean ages of above 50 years; it is only to be expected that all three would have a high incidence of retirement, illness and death. Factory Services and Labourers (all unskilled jobs) have a high incidence of dismissals, but Factory Services a small number of voluntary leavers, which to some extent offsets the dismissals. Storekeepers have more than double the average rate of promotions and transfers.

Summing up, with the exception of the three oldest jobs, and the Testers (whose figures seem to some extent to be an artifact), there are marked differences between the primary producers in the machine shop and those doing auxiliary jobs. Machinists, who are in short supply, tend to leave voluntarily, are likely to be transferred to other work, including setting, the normal first step to promotion, and are unlikely to be sacked. Only two or less out of every five work on the same job as they did eight years earlier. In the auxiliary jobs, one out of two remained in the same work, except for Plating and Heat Treatment and Inspectors, where the number is three out of five, Plating because of very low voluntary leaving and Inspectors because of very low movement to other work. The three oldest jobs show a high rate of retirement, illness, death and dismissal; being relatively unskilled, replacement is somewhat easier than it is with skilled men.

Age Differences Between Jobs

We have already seen that there is a wide range in the ages of men on different work, however this is measured. We can therefore rank jobs both for 1947 and 1955 using one of these measures. This has been done, using median ages, in Table 4.

TABLE 4: MEDIAN AGES OF MEN ON VARIOUS JOBS IN FIRM A, 1947 AND 1955

JOB	MEDIAN AGE 1947	MEDIAN AGE 1955
Electricians	29.38	35.28
Capstan Operators	31.80	29.80
Pattern Makers	33.00	31.50
Fitters (skilled)	34.16	44.20
Borers	34.50	38.00
Instrument Makers	34.71	36.54
Millers	35.41	35.44
Grinders	36.49	37.50
Turners	36.64	37.90
Testers	37.17	39.80
Profilers	38.00	36.60
Polishers	39.27	43.70
Drillers	39.94	42.80
Inspectors	40.78	43.60
Fitters (semi-skilled)	40.87	48.84
Plating and Heat Treatment	43.57	48.83
Foundry Workers	46.45	45.00
Storekeepers	48.30	52.22
Factory Services	53.25	56.83
Labourers	53.69	57.12

Using Kendall's ranking method, we find the correlation between the two sets of medians to be *tau* = .733, which is significant at $P < .001$. Similar ranking, using mean ages and percentages over 44 years of age, give correlations of *tau* = .845 and .752, respectively. Analysis of variance of the ages of individuals in the jobs in 1947 and 1955 gave highly significant variance ratios for 'between jobs' sources of variance, and no other significant ratios. It seems, therefore, that there has been little or no difference in the rank order of jobs according to age as between 1947 and 1955.

These results are all the more remarkable when it is remembered how small are some of the age differences between jobs, and how much the firm's population has changed over eight years, both in overall distribution of ages and in actual personnel in the jobs. Additionally, the industrial and social climate has radically changed and the firm itself had to operate a redundancy which was followed by an internal re-organisation and a basic change in the nature of the product. Yet, in spite of this, jobs staffed by older men in 1947 are still staffed by older men in 1955. Older men seem to have kept off or left the same jobs in 1947 as in 1955.

About the only factor which has not changed between 1947 and 1955 is the nature of the job, and it seems quite clear that this is the most likely cause of the age differences we have found. We can, therefore, answer the questions posed at the beginning of this report and say that men, as they get older, do appear to find it increasingly difficult to continue working on some jobs with optimum efficiency, and therefore leave these jobs, and that these are the jobs which are avoided by older men. We can say, moreover, that these jobs are generally regarded as the more highly skilled.

SUBSIDIARY FINDINGS

Our study of age structure was designed primarily to answer certain questions regarding the age characteristics of jobs. However, the data collected in Firm A produced information on several other aspects of ageing. In this concluding part of the report subsidiary findings will be discussed, and possible applications of some of the findings will be suggested.

Age of Engagement

One thousand six hundred and ninety-seven men who were employed in Firm A in 1947 left during the following eight years. The age at which they had been taken on and their length of service are given graphically in Figure 5, which covers all causes of leaving except dismissal and promotion or transfer (i.e., retirement, illness, death and resignation). This curve indicates that men taken on under 21 years of age or between the ages of 41 and 52 years tended to stay longer in the firm before separation than men who were younger or older. Men between 25 and 28 years of age were a particularly bad risk, their expectation of service being only two-thirds of that of a man of 40 years of age.

This presentation which covers all causes of leaving except dismissals and promotions or transfers is perhaps of greatest practical importance, but of no less interest is the pattern of voluntary leaving. This is best shown by means of contingency tables. The expected frequency of leaving in each cell has been calculated on the assumption that there is an equal probability of men leaving voluntarily whatever their age of engagement.

FIGURE 5

RECRUITMENT AGE AND MEAN LENGTH OF SERVICE OF MEN LEAVING FIRM 'A' – 1947 – 1955

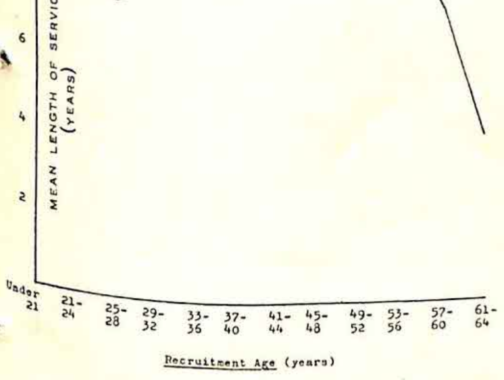


FIGURE 6

VOLUNTARY LEAVING FROM FIRM 'A' – 1947 – 1955

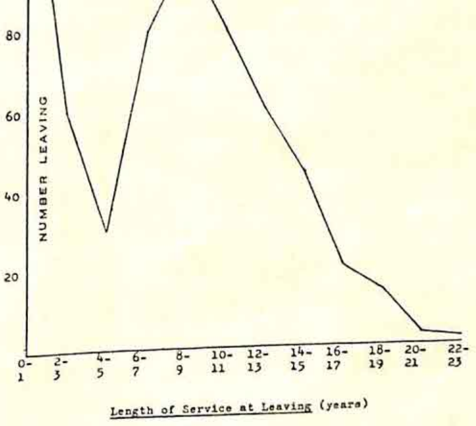


TABLE 5: VOLUNTARY LEAVING AND RECRUITMENT AGE

	AGE OF RECRUITMENT					TOTALS
	21-28	29-36	37-44	45-52	OVER 52	
Observed Number of Voluntary Leavers	224	184	64	45	20	537
Expected Number of Voluntary Leavers	175.6	155.8	106.8	69.3	29.6	537.1

($\chi^2 = 47.22, P < .001$)

Table 5 gives the data for all voluntary leavers irrespective of their length of service. It shows that more men have left below the age of 37 years than is expected, and less at the age of 37 years and over. The trend demonstrated in this table is highly significant ($\chi^2 = 47 \cdot 22$, $P < \cdot 001$). Thus the very young are on the whole more liable to leave and the older men, particularly those engaged between 37 and 44 years of age, are more likely to stay. This trend is not consistent over the whole range of length of service as is shown by Table 6. In this table, cells appearing substantially deficient are marked −, and those substantially in excess are marked +. It will be noticed that the number of men of over 36 who leave with four to five years service is more than is expected.

TABLE 6: VOLUNTARY LEAVING, RECRUITMENT AGE AND LENGTH OF SERVICE

		AGE OF RECRUITMENT					TOTALS
		21-28	29-36	37-44	45-52	OVER 52	
Length of Service (Years)	Under-2	63+ (42.5)	39 (37.7)	20− (25.9)	7− (16.8)	1− (7.2)	130
	2-3	17 (18.3)	22+ (16.2)	5− (11.1)	9 (7.2)	3 (3.1)	56
	4-5	4− (8.5)	6 (7.5)	7 (5.2)	3 (3.3)	6+ (1.4)	26
	6-7	17 (23.9)	33+ (21.2)	12 (14.5)	10 (9.4)	1− (4.0)	73
	Over-7	123+ (82.4)	84 (73.1)	20− (50.1)	16− (32.5)	9− (13.9)	252
	Totals	224	184	64	45	20	537

($\chi^2 = 110.03, P < .001$)
(figures in brackets refer to expected cell frequencies)

This is particularly interesting when viewed against the total pattern of voluntary leaving which is given in Figure 6. As would be expected there is a high incidence shortly after engagement, dropping to a minimum at 4 to 5 years, and rising to a peak at 8 to 9 years. Why more men over 36 years of age should tend to leave after four or five years service we have been unable to discover, but it suggests that employers might with advantage consider their men over 45 years of age who have been with them four or five years, to see if those who might leave can be induced to stay on.

From these results it is clear that the saying 'too old at forty' is a fallacy. It seems likely that men over 37 years of age will give longer service than those who are younger, and that less of them will want to leave voluntarily. The best age for engagement seems to be between 37 and 44 years, and the worst 21 to 28 years.

In considering these results it should be remembered that this is an analysis of leavers who were present in Firm A on 1 January, 1947. They are not comparable with data obtained by keeping 'running records' which will be biassed heavily by short service men who, as we have seen, will tend to be young. It is all the more interesting, then, that these results are so favourable to the older men. If 'running records' had been kept, the superiority of the older men in this respect would, we think, have been even more marked.

Strictly, these findings apply only to Firm A. However, the similarity of the age structure of Firm A to that of the other firms we have studied (except Firm G) suggests that it may well be more general. Only a full analysis of the leavers of the other firms would settle this point with certainty.

Internal Migration

The movement between jobs during the eight years was studied. With the possible exception of the Inspectors, almost all the movement was towards what is generally regarded as being more skilled work. The Inspectors, it might be argued, are of a skill equal to the machinists, although we feel that the demands of inspection are unlikely to be as heavy as those of machining. It would appear that men finding their jobs too much for them as they get older do not, possibly for prestige reasons, move to an 'easier' job, but rather leave the firm altogether. An exception to this is inspection which appears to have high status, but, according to the Labour Department, men from other jobs are usually moved to this for health reasons when they need a 'light' job. It seems to us unlikely that a skilled man will often admit that he can no longer cope but will prefer instead to make a move.

The effect on leaving of moving men from one job to another can be seen from the following data. Of the 2,613 men who remained on the same work, 43% stayed in the firm and 22% resigned; of the 528 who were transferred to other work, 63% stayed and 12% resigned. In both instances 10% were promoted or transferred. From these data it looks as if moving men, which as we have seen usually means moving them to a 'superior' job, tends to counteract any desire to resign which may develop. This seems to suggest that a deliberate policy of internal transfer to 'superior work' could be adopted with some confidence.

Age Differences between Productive and Non-Productive Workers

During our discussions on what happened to the older skilled men who appeared to have left the firms we studied, it was frequently suggested to us that they moved into non-production jobs such as maintenance work. While we could obviously not test this hypothesis in relation to men who had actually left we could see whether the older men who had stayed tended to be in jobs auxiliary to the primary production.

Two groups in Firm A lent themselves to this analysis, the skilled Fitters and the Machinists.

The Fitters can be divided into five categories:

(a) productive, working in the machine shops on tasks directly connected with the machining of parts;
(b) assembly, working in assembly shops on building up the finished product;
(c) non-productive, working mainly in the tool room;
(d) maintenance, keeping the machines running;
(e) outside maintenance, working away from the factory, looking after the firm's products in the field.

The Machinists can be divided into two:

(a) productive, working in the machine shops;
(b) non-productive, working in the tool room.

The results are given in Table 7. This table shows that the oldest fitters were those directly associated with production, that is, groups (a) and (b), while the youngest were those working on maintenance. It is not surprising that there were fewer older men working on the outside jobs, but of the inside jobs the exact reverse was found to that which we had been told to expect.

TABLE 7: PRODUCTIVE AND NON-PRODUCTIVE WORKERS

	NUMBER	MEAN AGE	% OVER 44
FITTERS			
Productive	73	45.53	50
Assembly	192	44.77	51
Non-Productive	95	41.34	41
Maintenance	147	42.77	40
Outside Maintenance	35	42.89	32
MACHINISTS			
Millers - productive	214	36.57	22
Millers - non-productive	22	33.50	10
Grinders - productive	135	36.50	32
Grinders - non-productive	37	40.59	32
Turners - productive	153	38.06	25
Turners - non-productive	19	39.84	25
Borers - productive	39	38.00	23
Borers - non-productive	10	32.00	0

The machinists are not quite so clear cut, but we can say that they produce no evidence to support the general suggestion that older skilled men move away from direct production work.

The men in the tool room are some of the most highly paid in the factory, and it seems reasonable to assume that the firm must regard them as amongst their best workers. Yet they tend to be younger than men on production. It would seem, therefore, that the belief that high degrees of craftsmanship come only with age is invalid.

This finding applies, of course, to Firm A where there is no mass production and where men are not working to tight rates to earn a bonus. On the other hand, neither are men in any of the other firms, except Firm G, which participated in this study. We know from previous work (Belbin, 1953) that where time stress is present, as it usually is under mass production, older men do tend to move to jobs where the stress is less, but it seems from our results that this does not occur when skill rather than speed is the predominant factor in the work situation.

Men Approaching Retirement

In 1947 there were 304 men who were 57 to 64 years of age and who would therefore all have reached retiring age by 1955. Similarly, there were 468 aged between 49 and 56 years who, eight years later, were approaching the end of their industrial life. Table 8 shows what happened to these men.

TABLE 8: MEN APPROACHING RETIREMENT

1947 AGE	NUMBER	STAYED	LEFT VOLUNTARILY	DISMISSED	RETIRED	ILL	DIED	PROMOTED/ TRANSFERRED	CHANGED JOB 1947-55
49-56	468	295	57	57	1	12	46	0	97
Percentage	—	63.2	12.2	12.2	—	2.6	9.9	0	20.8
57-64	304	81	39	66	54	21	43	0	38
Percentage	—	32.4	15.6	26.4	—	8.4	17.2	0	15.2
All Other Ages Percentage	—	45.5	22.9	16.1	0	1.3	2.3	11.9	16.6

Of the 304 men who could have retired by 1955 only 54 actually did so; 250 were disposed of in other ways, and the percentages given for comparison with men under 49 years of age are of all separations except retirement (any other comparison would be invalid because the retired are, with one exception, concentrated in the over-57 age group).

As we should perhaps expect, a larger proportion of older men died or left because of chronic illness. On the other hand, the proportion leaving voluntarily was rather less than half that for the whole firm, while for the 57 to 64 age group the proportion dismissed is almost double.

The general picture which emerges from this is that men who have reached their 50th birthday are much less likely to leave the firm voluntarily than those under 50 years of age, and they are equally likely to change their job. The over-56 age group was rather heavily hit by redundancy, but this is specific to Firm A. What is more interesting is that substantially more men decided to work on after retiring age than actually retired.

CONCLUSIONS

The results reported here suggest the existence of a definite age structure in firms in the engineering industry in the South-West of England. The rankings of jobs by age are substantially similar in all the firms studied, and these rankings appear to have been the same eight years before the investigation was made. It appears that the largest single determinant of age structure is the difficulty inherent in the job itself, and we believe that the isolation and identification of difficulties inherent in jobs will lead us to modifying and re-designing jobs in a way which will enable personnel to continue their employment in them beyond the age at which they appear at present to leave them. If this is possible a substantial contribution to productivity should result.

Although it seems that difficulties inherent in jobs must be the largest source of age-differences between jobs we cannot, on the evidence adduced, completely discount other factors. However unlikely it may be that deliberate employment policy or social causes, for instance, are operating in producing the age-structure found, these cannot be overlooked as contributory causes of age-differences, at least.

A very important question which this work leaves unanswered is that of what happened to those workers who left the 'young' jobs. A study of these men may well provide indications as to the difficulties inherent in the work they left and the various influences which acted upon them in deciding to leave.

The Unit for Research on Employment of Older Workers is actively pursuing these and other lines of research.

ACKNOWLEDGMENTS

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Psychologists in the Australian Civil Service

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IT is not my intention to present a descriptive account of the activities of psychologists who are employed as such in the Australian civil service, whether in the Commonwealth public service or the public services of each of the States. Rather do I propose to examine some of the difficulties associated with the roles taken up by psychologists who become members of the civil service as an employing institution.

I think this subject not unimportant for at least two reasons. First, there is little doubt that the majority of psychologists in Australia are employed in one or other of our public service systems. Moreover, with the developments that have already taken place and are likely to continue, although perhaps at not such a rapid rate, in education and various forms of social service, it can be expected that an increasing number of psychologists will be employed by agencies of Government. It is important, therefore, that those responsible for the training of psychologists and that those being trained should have some appreciation of the civil service as an employing institution and of what may be required of psychologists who seek in it a career. Second, there is also a need for psychologists outside the civil service, who may have occasion in the course of their work to deal with it, to understand the service better; and in any case as professional psychologists they cannot be indifferent to what fellow psychologists are doing or not doing within the civil service system.

I propose, therefore, to examine the Australian civil service as an employing institution in terms of three variables adopted by Elliott Jaques (1951) in dealing with a factory as an employing institution, namely function, structure and culture.

THE FUNCTIONS OF THE CIVIL SERVICE

Traditionally, the primary function of the civil service as we know it in British Commonwealth countries was to administer the law of the land as promulgated by Parliament in Acts and Regulations. This is still the primary function of many Government departments and instrumentalities and has some place in most, if not all, of them. The exercise of this administrative function has called for objectivity, impartiality and consistency of behaviour. In general, the approach adopted has tended to be predominantly legalistic and impersonal. It is for this reason, perhaps, that psychologists as psychologists do not appear to have been particularly well suited to civil service administration. It may be that the processes of natural selection whereby individuals decide to become psychologists, and their subsequent training, give them a heavy bias in favour of both the scientific and humanistic, as contrasted with the legalistic and impersonal, approach to problems. Thus psychologists are apt to become impatient with the appeals of administrators to authority, the literal interpretation of rules and regulations, precedent and to what is often referred to rather vaguely as 'policy'. Yet sooner or later, particularly as they rise to higher positions, psychologists in the civil service will become involved directly or indirectly in the administrative function of the arm of the civil service to which they belong, and in this the acquisition of administrative skills will become increasingly important.

A second function performed by the civil service is that of advising the Government or organs of Government on the formulation and development of Government policy. It should be noted that with the growing complexity of governmental activity, particularly in areas involving highly technical considerations, for example, international finance and atomic energy, the determination of policy is tending to move from the responsible Cabinet Ministers and Parliament to the civil service. (In this connection, it is relevant to point out that political scientists have argued that sovereignty which was originally vested in the monarch, was then assumed by the barons, and then Parliament, is now passing to the civil services.) However, psychologists as civil servants may not always fit easily into activities which are concerned primarily with the creation or the formulation of policy. Policy-making in the civil service does not ordinarily proceed from a scientific examination of facts and a decision as to the most efficient way of dealing with problems revealed by this examination, though this is the approach that the trained social scientist would expect to be taken. Policy-making must take account not only of the overall policy of the government of the day to which the civil servant is committed to serve, irrespective of its political colour or his own political beliefs, political considerations as such often cannot be ignored. Constitutional considerations, in Australia particularly in relation to the respective powers of the Commonwealth and the States, may set limits as to what can be done. Moreover, the policy-maker must always consider the effect of the implementation of policy on the relations between departments, outside organisations, the taxpayer, professional lobbyists and the public generally.

In recent years we have seen the rapid development of a third function of the civil service, that of providing various types of service to the community or particular sections of it. It is in this field that psychologists are most commonly employed, for example as school counsellors in State Education Departments, as diagnosticians in the Acoustic Research Laboratories of the Commonwealth Department of Health, vocational guidance officers and industrial psychologists in the Department of Labour and National Service, and so on. The provision of services such as these ordinarily brings in its train the development of research activities with a bearing on the services being provided or developed. It is in these service and research activities that the psychologist is much more at home, because it is probable that he will be employed very largely, if not exclusively, on duties in which he can use his professional knowledge and skills. He may also be relatively free from purely administrative and policy-making functions and may have a reasonable degree of professional independence. There are, however, three cautions which should be sounded:

(a) It is possible that the psychologist will find that he is obliged to operate in accordance with a policy, which may involve what he considers to be professional considerations, in the formulation of which he has played little or no part.

(b) The psychologist may be immediately responsible to, and if not immediately, ultimately to a senior officer who is not a psychologist, perhaps one who has no professional qualifications of any kind. This possibility is unavoidable in that in the civil service system an officer at any level of the hierarchy is held responsible for the actions of all those who are subordinate to him. At the top the Permanent Head is responsible to his Minister, who is responsible to Cabinet and Parliament, broadly speaking, for the actions of all members of the department. This principle which is basic to the civil service appears to be a fairly common source of a sense of frustration on the part of psychologists (and other professional personnel, too) employed in the civil service. The psychologist, particularly if he is battling for professional status, may resent receiving direction from a senior officer who in psychological matters is essentially a layman.

(c) The psychologist joining the civil service will find that either his nuclear work group or the extended work group will contain colleagues drawn from other disciplines and some whose only claim to expertness is that derived from years of experience in the service. This situation can present problems of communication and understanding, and if the entry of the psychologist is perceived as a threat to vested career interests tension can result. Indeed herein lies one of the major but scarcely recognised problems of some of the older civil service systems overseas and, perhaps to a lesser extent, in Australia: the entry into the service of various types of professional worker who in virtue of their specialist knowledge and skills can be seen as a very real threat by well-established civil servants whose training and background have been exclusively non-technical and administrative. Accordingly, there has been a very great reluctance to accept the role of the specialist in some civil service systems even in fields in which expert technical knowledge is now quite essential.

It will be noticed that in dealing with the functions of the civil service, only passing reference was made to research. The fact is that research has only relatively recently been given a significant place within the civil service of most countries, including Australia. It is still sometimes argued that research is not properly a civil service function and should be undertaken by individuals and organisations outside the service: for example, by universities, research institutes, foundations and private individuals. The argument is that research by its very nature implies the possibility of change in existing policy, change which should be initiated not by the civil service but by Parliament. Presumably it is assumed that Parliament, the members of which are elected to carry out the wishes of their electorates, will in due course be influenced by a public opinion that has become informed as the result of research. Perhaps in less sophisticated form this point of view is held in some quarters in Australia: thus when public opinion or political pressure demands some cutting back of staff and expenditure in the public service, research staff and research activities may be selected for special attention.

Irrespective of the validity of these observations, it would be true to say that the civil service does not always provide the most congenial setting for research activities. The effective conduct of research ordinarily requires flexibility in organisation and in the deployment of staff, reasonable freedom from the restrictive effect of rules and regulations, and a willing acceptance by higher authority of the possibility that the research results may be negative, inconclusive, or even in conflict with existing policy. These are conditions not easy to obtain within the civil service system as it is.

A further difficulty is that the civil service does not always attract and retain those best suited to research, particularly as status and salary are not usually related, at least in Australia, to the technical competence of the individual occupying a particular research position but are based on considerations which may have virtually no bearing on research competence; for example the number of staff controlled, the relation of the position occupied by the research worker to other positions in the hierarchy, and the degree of delegation, especially in financial and similar matters, exercised by the occupant of the position.

Despite these limitations, however, it is evident that research is bound to play an increasingly important part in the work of the civil service. Much of the research required by the circumstances emerging in our modern society, particularly in the physical sciences, is beyond the resources of private individuals or organisations although, of course, this need not mean that the research which the Government is therefore obliged to sponsor need be performed within the civil service as such. Rightly or wrongly, however, the tendency has been for Government-financed research to be brought more and more within the ambit of the civil service. Then again there is a good deal of research which requires access to data which for security or high policy reasons cannot be made readily available, if at all, to individuals outside Government employment and therefore not under direct Government control. This whole question, of course, raises a number of issues of considerable concern to the scientist; for example, to what extent is the scientific integrity of the research worker threatened when he comes under Government control; under what circumstances is he free to disclose the results of his research to other scientists in his own and other countries, and so on.

CIVIL SERVICE STRUCTURE

When we turn to the structure of the civil service as an employing institution, our second variable, we find that it is characterised by a highly formal, relatively rigid, hierarchical organisation. The hierarchical organisation flows very largely from the principle of responsibility and accountability alluded to earlier. In any case, it is probably true to say that no large-scale employing institution, whether public or private, could function effectively without some form of hierarchical organisation.

Once an hierarchical organisation such as the civil service has become well established, it is apt to become highly formalised and somewhat rigid in structure. Depending on the functions of an organisation, within limits this need not be a weakness: if the organisation is large, too much flexibility and frequent change can prove very costly and may lead to inefficiency. What is often referred to as 'red tape' was not designed as a means of avoiding or preventing action, as sometimes may appear, but rather to provide the cohesion and system required if a large organisation is to operate efficiently.

Psychologists entering the civil service may have difficulty in adjusting to the requirements and procedures of this type of organisation. They have been trained to challenge theories, propositions and ways of behaving, irrespective of the status of the organisation or the individual responsible for them. They may not be impressed by the need for observing protocol and operating according to rigid rules and formal procedures, however hallowed by tradition. If psychologists, full of reforming or non-conforming zeal, try to 'buck the system', however, they are not likely to succeed and may find that their efforts to develop the activities for which they are responsible are going to be frustrated. They may well find themselves pushed away into a corner where they won't be a nuisance. On the other hand, there is a serious danger that if psychologists uncritically accept the system as they find it, before long they may lose sight of the distinctive contribution they can make as psychologists. They may get on, but psychological development suffers and the civil service will be the poorer.

THE CULTURE OF THE SERVICE

The functions and structure of the civil service as outlined above give to the civil service its distinctive culture, a culture that in turn influences the way in which functions are developed and structure remains relatively constant or undergoes change. The concept of culture being adopted here has been defined by Elliott Jaques as the customary and traditional way of thinking and of doing things, which is shared to a greater or lesser degree by all the members of an organisation, and which new members must learn, and at least partially accept, in order to be accepted into the service of the organisation. Jaques (1951, p. 251) goes on to point out that ignorance of culture marks out the newcomers, while maladjusted members are recognised as those who reject or are otherwise unable to use the culture of the organisation. In effect, culture consists of the established patterns of behaviour which lie at the disposal of the individual for handling his relationships, and on which he depends for making his way among, and with, other members and groups.

It is not possible within the limits of this article to describe in any comprehensive way the culture of any particular civil service system in Australia, for example, the Commonwealth public service, or the cultural variations which exist, as sub-cultures, from one department to another or even within one department. These variations and the possibility of conflict between them, of course, are quite important for the adjustment and acceptance of an individual entering the civil service. They are equally important for top administrators and supervisors who are sometimes unaware of the significance of sub-cultural variations for their administration. Neither is it possible, even if it were necessary, to deal here with the popular notion of the culture of the civil service as represented by the stereotypes of the newspaper cartoon and funny story, which would have one believe that the civil service is a rest home for unimaginative, ineffectual morons who spend their time tying up papers with red tape and transferring them from an 'action' tray to an 'action pending' tray.

For the purpose of this discussion, only one feature of the culture pattern will be selected: the pervasive pressure to conform to the value systems, attitudes and behaviours which might be broadly described as belonging to Anglo-Saxon middle-class morality of a generation ago. The strength of this influence might be explained, at least in part, in terms of the functions and structure of the civil service and the cultural lag common to all large organisations and social institutions. To some extent the pressure to conform is codified and sanctioned in the Acts, Regulations and Orders covering civil service operations. It is also implicit in the nature of the instructions and procedures which are usually found necessary in the conduct of the affairs of any large-scale organisation. It is also to be found in the traditional ways of doing things, unwritten law and other forms of group sanctioning, without which there would be no guarantee of cohesion and stability.

This pressure to conform has many facets. The civil servant in Australia is expected to have special respect for Authority and Law, not only insofar as the administration of the law may be part of his duties but also in his behaviour outside official hours. Thus the Commonwealth public service provides certain sanctions which may be automatically applied in the event of an officer coming into conflict with the law as a private citizen. Allied to this respect for authority and law there is a tendency towards literalism in the interpretation of the written word which sets a premium on conformity and tends to inhibit the adoption of individual points of view. The civil servant, both in his official and unofficial capacity, is expected to observe what is regarded as conventional morality. (In passing it might be mentioned that, at least until recently, in the civil service in the United Kingdom involvement in divorce proceedings could be regarded as an impediment to promotion to high office.) The civil servant is expected to conform to certain standards of dress, which do not include crew-neck sweaters, T-shirts, sports coats and slacks and the like. Extreme or radical opinions on contemporary, political or social issues are not encouraged. Much emphasis is placed on such respectable virtues as punctuality, adherence to routine and orderliness.

The deviant from this pattern of conformity is not likely to be readily accepted by his group and may come into conflict with those to whom he is responsible. This cultural demand may present some problems of adjustment for the psychologist. As various studies have shown, psychologists as a class tend to fall at the radical end of the radical-conservative scale, more or less irrespective of the content of the social attitudes being considered. Thus whereas many civil servants, perhaps the majority, may have been attracted consciously or unconsciously to the civil service because they have perceived it as the embodiment and custodian of the value system incorporated in their way of life, this may not be so of psychologists as a class who may be critical of, if not actively opposed to, at least some of the values for which the civil service appears to stand.

It is important that psychologists should be aware of this possible conflict of attitudes so that they can more effectively handle their relationships within the civil service. Some compromise, based on insight, may be necessary if psychologists are to be able to meet the point made by Elliott Jaques that new members of an employing institution must learn, and at least partially accept, the culture of that institution if they are to be accepted into its service, are to make what will be regarded as a satisfactory adjustment and be in a position to operate the culture in the handling of their interpersonal relationships.

Obviously this account of the civil service in Australia has necessarily been at a very broad level of generalisation and provision could not be made for the quite considerable variations in function, structure and culture that occur from one public service to another or within one particular service; and it is possible that in the process of abstracting and generalising some distortion has crept into the picture presented. At the same time, it could be that the level of generalisation will permit some application of the points raised to civil service systems in other countries which have adopted the British pattern.

THE NEED FOR PSYCHOLOGISTS

The conclusion should not be drawn from what has been said above that psychologists are neither needed nor wanted within the civil service in Australia. That would be far from the truth. The fact is that in Australia virtually every Government department and agency which employs psychologists is finding it chronically difficult to obtain the psychologists it needs. More often than not one organisation can only maintain its strength by attracting staff from another. There is little doubt that in the fields covered by both the Commonwealth and State public service systems urgently needed services are being denied the community because the necessary psychological personnel are not available. Moreover, staff with psychological training are needed for quite a wide range of positions which are not specifically psychological and are not classified as such, for example, positions as general research officers, personnel officers, training officers, organisation and methods officers, and so on. Further, it could be argued that it is time that psychologists provided some leaven in the administrative lump of the civil service, which would mean, of course, their being prepared to accept appointment and promotion outside their professional field. Particularly at the highest levels of policy-making when issues relating to human behaviour may be fundamental, there is surely a need for the contribution of the psychologist, if only to remind policy-makers that they are dealing with people, whether as individuals, groups, communities or nations.

Not only does the civil service in Australia need more psychologists, it needs better psychologists. It is probably fair to say that civil service employers of psychologists in this country are very often disappointed at the quality of the psychologists offering. A not uncommon weakness is that although the psychologist may have acquired a relatively high degree of competence in the application of the particular techniques in which he has been trained, he may have very little appreciation of what is involved in applying these techniques within an institutional framework such as that provided by the civil service, and may have insufficient understanding of how to handle his role relationships as a psychologist in dealing with other members of the institution and in dealing as a civil servant with those outside, the general public. The psychologist entering the civil service needs not only to be technically competent as a psychologist, he also needs the understanding and motivation that will enable him to become an efficient civil servant.

This article has not been concerned with the first requirement, that of professional competence: it has sought to present some observations which may assist psychologists in understanding and complying with the second, that of being an efficient civil servant. In this, the starting point is for the psychologist to have an appreciation of the implications of his two major roles and the relationships that flow from each role—that of a professional psychologist and that of a civil servant occupying a particular position in the system. There is also a third role, which has only been touched on by implication, that of a citizen in the community of which he is a member.

Although comparative statistics are not available, it is my impression that the place of psychologists in the civil service is being more readily recognised in Australia than in most other countries with comparable civil service systems. While there may be still some resistance within the civil service in some places to the employment of psychologists and to granting them status and conditions necessary if they are to be truly effective, useful developmental points have been established. Further progress is likely to be determined very largely by the availability of sufficient psychologists interested in and suitable for civil service employment.

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Shackle's Theory of Expectations and the Definition of Rationality

By DAVID C. DUNCAN

CO-OPERATION between psychology and economics has in the past been the exception rather than the rule. For this there would appear to be three main reasons: the difficulty which the economist finds in obtaining answers for the psychological questions which he asks; the difficulty which the psychologist finds in understanding the origins, aims and nature of the economist's explanation of human behaviour, and his consequent inability to contribute to economic thought; and the lack of interest of each in the field of study of the other. The last has arisen out of the first two reasons, but inasmuch as it has become a habit, it is an obstacle in its own right.

In the first place, psychologists have learned by now not to try to find direct answers to questions such as "Do animals think?", "Do machines think?", "Is my mental experience on seeing Niagara Falls comparable with that of my neighbour?", "Do I have a greater capacity for feeling joy than my neighbour?" They may try to produce an answer by indirect means, by defining 'thinking' or 'mental experience' operationally, or by making certain simplifying assumptions such as that verbal statements and overt behaviour signify that experience or mental activity of a certain sort and intensity is occurring. But more usually psychologists shelve these questions as unanswerable, 'meaningless', irrelevant or posed in the wrong fashion. In learning these procedures, psychologists are probably more indebted than they realise to the efforts of J. B. Watson and his followers for encouraging them to study behaviour, and use an operational approach, and discouraging them from introspection.

Economists on the other hand have not had the benefit of this tradition. Some, such as von Mises (1949) seem to consider that psychologists are either psychoanalysts or introspectionists. Others (e.g., Robbins 1953) consider that any attempt by economists to use a behaviouristic approach would be found too constricting. Consequently economists wallow in a psychological Slough of Despond trying to decide whether utility is measurable, whether interpersonal comparisons of satisfaction are possible, and whether one person has a greater total capacity for satisfaction than another. Unable to find a direct unequivocal answer to these questions they have tended to shelve them by turning their backs on them and studying instead quantities which can be more easily defined and manipulated.

On the second point, one might have expected of psychologists that they would approach the study of economics in an objective fashion, first trying to understand the economic approach, and the economist's explanation of human behaviour, rational man. One might have expected them to find out how and when the explanation was formulated, consider what economists were trying to achieve by explaining human behaviour in this way, and why the explanation took the final form that it did. They would then be in a position to identify the nearest equivalent in psychological theory, and would have a real appreciation of what psychological explanations and techniques would meet the needs of economists. In fact quite the opposite has happened. Psychologists, instead of enquiring into the origins and aims and circumstances of the economist's approach, have tended to condemn him off-hand for not being sufficiently inductive, or sensitive to public opinion or the irrationalities of human conduct. For example, instead of enquiring into the *raison d'être* of rational man, Thouless (1951) attempted to demolish him; and the newer ideas of Keynes about general psychology fared no better at the hands of Katona (1951). In short, the psychologist has tended to see the economist as something of a reactionary, while in the economist's eyes the psychologist has gained something of the reputation of an iconoclast.

The third point now needs no amplification. Once both parties have decided that the no-man's land is fruitless territory to explore and that the prospects of co-operating with the party on the other side are not bright, both lose interest and divert their attention to problems of more central importance in their field of study.

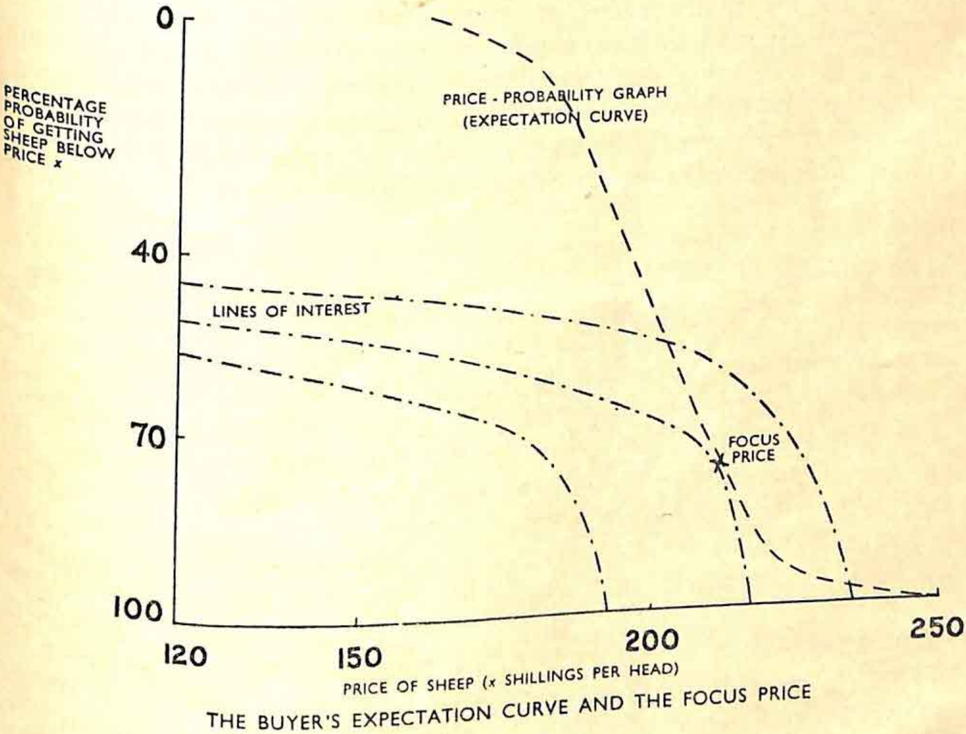
This unsatisfactory situation now shows some signs of improving. There have, of course, been exceptions to this. Knight (1921) wrote at length on the importance of psychology in economic affairs. Economists such as Marshall (1910) and von Mises (1949) have provided their own answers to the question "Why do people work?". Perhaps most remarkably, Pigou (1929), in putting forward the 'psychological' theory of the trade cycle, anticipated by decades the 'principle of expectancy' recently put forward by Allport (1954) and the 'Self-Fulfilling Prophecy' mentioned by Brown (1954). In general, however, a state of mutual indifference has prevailed.

The future, however, is somewhat brighter. The American psychologist and economist Katona (1953) has pointed out that many aspects of behaviour, among them problems of expectation and rationality, can be studied most fruitfully in the economic field. The phrase is well turned, reminding the psychologist that he can study such problems of expectation, problem-solving and decision making as they affect the business man; and the economist that, if he likes, he too can do some inductive research or theory construction on these topics in his own field; and both, that there are possibilities of their co-operating in such research.

In particular, what appears to be a useful approach has been made to the problem of analysis of expectations and uncertainty by the economist, Shackle (1954, 1955). The purpose of this article is to attempt a psychological interpretation of the theory of expectations advanced by Shackle, and try thereby to throw some light on its practical implications and on the meaning of the term 'rationality' as used by economists.

The situation chosen for examination is one where an individual has to make a once-only decision to spend a sum of money, and the problem is one of how to describe the main variables in the situation. The example taken will be that of a farmer who is buying 50 ewe lambs for breeding purposes at a sale of 14,000 of these in 200 lots of 50 and 100. What can we say about the pattern of expectations which leads him to buy at the price he does? He will know as a matter of course that there will be a range of prices and that few sheep will be sold at the top of that range and the bottom of the range and that many will be sold at the middle of the range. His subjective assessment of the prices corresponding to the various parts of the range will be made from what he thinks are relevant cues—the same sale at the same place last year, previous sales of different stock at this place this year, or of the same stock in other places this year, and any data on price trends. The final result might be diagrammatically expressed in the form of a graph showing his assessment of the probability of getting what he wants below a certain price. Given the range, what will determine the price at which he will buy? What will make it, at the point of purchase, the most attractive price, to him for the goods?

There will be three forces affecting the attractiveness of the price which he eventually pays. Price will attract him towards the lower end of the range as he will wish to purchase what he wants as cheaply as possible. Quality will attract him towards the upper end of the range as he will wish to purchase as fine sheep as possible at the price. If it is also assumed that he is trying to buy sheep of average quality the attraction of the top and bottom of the range will be less, since the probability of getting the desired goods at the desired price will be less there. His interest can then be expressed diagrammatically on the graph by lines of maximum interest. The



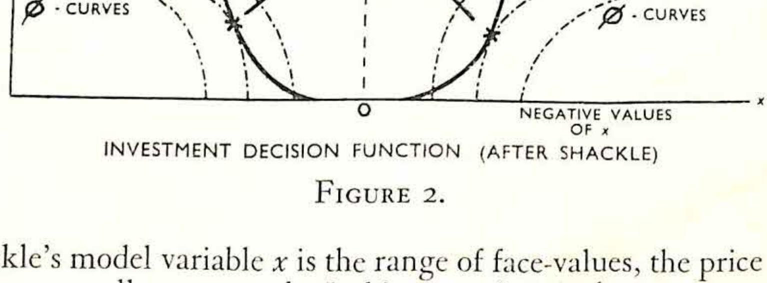
THE BUYER'S EXPECTATION CURVE AND THE FOCUS PRICE

FIGURE I.

'focus price' at which he will be most prepared to buy will be where the line of maximum interest cuts the price-probability graph.

This example was chosen with the object of using the variables suggested by Shackle in a life situation where it might be possible to study the decision to construct a model comparable with the one which he suggests. Some additional explanation, however, is required as Shackle's model is rather more complex than the one just described, and he has taken great care over specifying the rules of the game. Shackle states that the decision which he is studying is non-seriable and non-divisible. A decision such as is given in our example, might be divisible or seriable, as the buyer of a lot of sheep can 'split the lot' and take a smaller quantity of them if he so wishes. If our farmer wanted to buy 200 sheep, he could buy them in four lots of 50, which one could look at either as a series of four of a 'seriable' decision, or as one 'divisible' decision taken in four parts. These qualifications were made with the object of studying simplest cases first; our example can be subject to these simplifying assumptions, as the decision is not inevitably divisible or seriable, and in fact the farmer buying 50 sheep would have to buy them as one lot. No statistics are available on the percentage of buyers who buy more than one lot, but observation would suggest that it is small.

There is, however, a fundamental difference between our example and the type of decision which Shackle's model was designed to explain—the element of risk. The farmer in our example may have bought rather poorer quality than he expected at the price he paid, or he may have had to bid higher than he expected to get the quality he wished, but he at least got something for his money. Shackle, however, is concerned with the situation of a business man making a risky investment, or a gambler deciding on his stake. The range of probabilities still refers to a range of expected outcomes, but for each possible gain there is a possible loss if the bid does not succeed. Consequently Shackle's model has also a right-hand section giving negative values of x.



INVESTMENT DECISION FUNCTION (AFTER SHACKLE)

FIGURE 2.

In Shackle's model variable x is the range of face-values, the price at which business is eventually transacted. In his example it is the amount potentially gained or lost, in ours it is the price paid. Variable y is a range of potential surprise from a minimum of no surprise to a maximum of sheer incredulity. This we have translated into terms of subjective estimates of the probability of certain alternatives in a range of outcomes.

The author has not yet questioned a possible buyer to obtain inductively a range of probability expectations, but it should be possible to construct one, with the help of a co-operative subject. The lines of interest described earlier are called by Shackle ϕ-curves, and the 'focus-price' where the maximum value of ϕ on the y-curve is found is called by him the 'focus-gain' and has its counterpart the 'focus-loss'.

So far, this essay has merely attempted to present a simplified description of Shackle's model. However, it may also cast some light on the proper use of the term 'rational behaviour'.

Psychologists have long made a distinction between the geographical and the perceptual world. The geographical world is the world of scientific laws and complete information. It is the world of certainty, where everything is accounted for. The perceptual world on the other hand is the world as an individual sees it, an uncertain and subjective world where information is very seldom complete and beliefs and expectations often wrong.

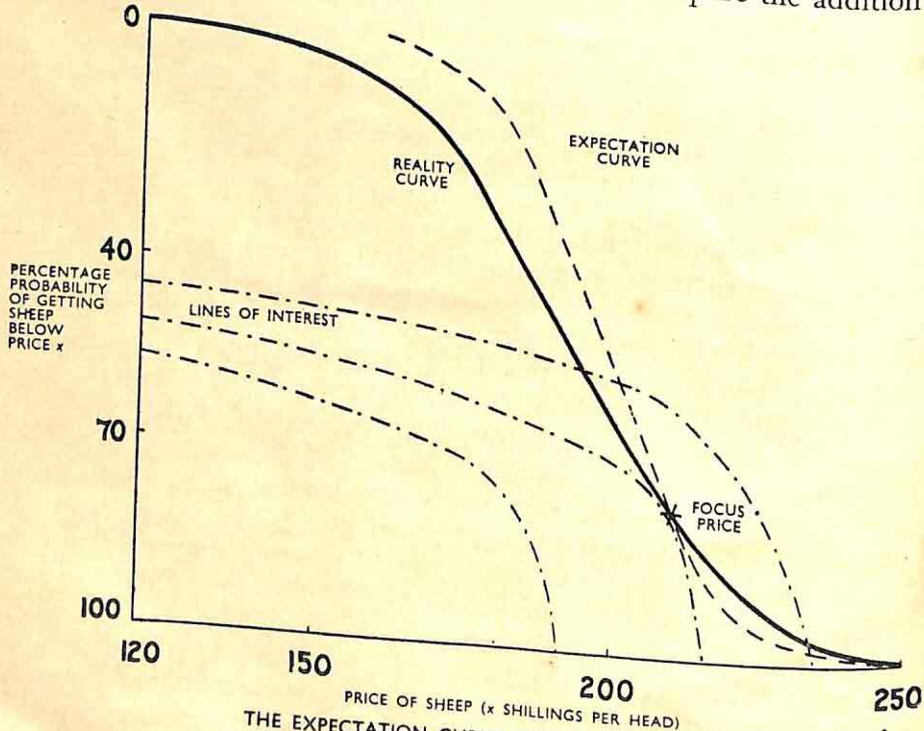
The mathematical economist, indeed anyone dealing with what may be called 'pure economics' assumes that decision makers possess complete information, that is that the geographical world is the only world that there is, that cues are always relevant and that behaviour is always rational. Their models might be described by a philosopher as syntactical systems, whose virtue lies in the consistent relationship of signs.

To the psychologist the claim of the economist to study only rational behaviour may seem odd, denying at the same time the primacy to the individual of his psychological world and the occurrence of individual differences. But this arises from his desire to describe the system in terms of an entirely different level of description from the psychologist. As Krech and Crutchfield (1948) rightly point out rationality is a sociological and not a psychological criterion. It involves two levels of description and is a judgment by a more abstract level of the correspondence to it of behaviour at a more concrete level. For example, a paranoiac may have a picture of the world as completely evil and populated by devils, 'rational' in that it is consistently integrated within itself, so that in the world as he perceives it there are no inconsistencies. At this, the psychological level, only the perceptual world is being considered and not its relation to the geographical world. When, however, the paranoiac is considered at the sociological level, in relation to cultural norms, his perceptual world does not correspond to the sociological norm of how people should perceive the world, the geographical world as laid down in his culture. In this, the more usual sense, his behaviour will not be rational.

The point at issue here is that the word rational is properly used only in describing correspondences between the perceptual and the geographical worlds, and is irrelevant or meaningless when applied to consistencies within these worlds. The psychological theorist who is concerned basically with relations within the perceptual world and the economist who is concerned with interrelations in the geographical world are interested in consistency within the system rather than its correspondence with other systems. Within these systems all behaviour is rational, so 'rational' loses its meaning. Explanations in terms of levels of description are comparatively recent, and the 'economic man' of the economists appears on consideration to be really a 19th century way of stating, "As an economist I choose to study people in the mass, and make generalizations about them at this level. Individual differences do not interest me".

Of recent years economists have not confined themselves so strictly to the strictly geographical level of description. Following the lead of the Swedish economists (e.g., Ohlin, 1948) and Keynes (1936) they have become interested in situations involving risk-taking and uncertainty, topics which would seem bound to involve them in descriptions at the perceptual level. Shackle's model of decision-making, however, which we are considering here, is a pioneer effort in that it considers the perceptual world as worthy of study in its own right, with all its possibilities of errors, and for this reason it is worthy of close attention by psychologists.

So far in our description of the model we have considered only the perceptual world of the farmer about to buy his sheep—what would be called by the Swedish economists the 'ex ante' view of the situation. Consideration of the same situation 'ex post' will give us the means of assessing the rationality of the farmer's judgment, but this will require the addition of



THE EXPECTATION CURVE AND THE REALITY CURVE

FIGURE 3.

another *y*-curve to represent reality. This is the 'decumulative curve' giving the 'ex post' or mathematical probability that the farmer would obtain his sheep below a given price.

To obtain this the distribution of prices was plotted for a sale of 14,000 ewe lambs sold in 215 lots of 50 and 100 in August, 1955. This sale has been further examined in another paper (Duncan, 1957). Figure 3 repeats the farmer's assessment, but superimposes the resulting distribution as a reality curve. It is interesting to note in passing that apart from a buyer's preference for leaving the bidding at or just above the 'round pound', which resulted in modal frequencies at these points, the distribution was normal. However, since sheep, too, have their individual differences this was to be expected.

Our concern here is with the rationality of the farmer's decision. It will be seen from Figure 3 that in fact his decision was a rational one, because at the focus price the reality curve corresponded with his own expectation curve. However, had the focus price been at any other point his decision would not have been rational. Had our farmer wished to buy better sheep he would have been surprised at how high a price he had to pay for what he wanted. Had he been content with sheep not so good he would have been surprised at the cheapness of his bargain.

The expectation curve of the farmer might also be related to his personality. The curve of a pessimist would lie to the left of the reality line, that of an optimist to the right and it would be quite possible for the complete range of expectations to be irrational. The relative sensitiveness of the farmer to price or quality might determine the slope of the curve. A sensitivity to price would result in a steep curve such as is shown, a sensitivity to quality would result in a more shallow curve, with associated tendencies towards buying more cheaply or dearer than the focus price. It would, of course, always be possible for the farmer's expectation curve to coincide with the reality curve throughout. In this case he would probably be in possession of full information, and any decision upon buying which he made would be rational.

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Errors of Aim and Extent in Manual Point to Point Movement

By G. J. SIDDALL, D. H. HOLDING and J. DRAPER

At the time this investigation was carried out the authors were all employed by the Ministry of Supply at the Clothing and Stores Experimental Establishment, Farnborough. Mr Siddall is now in the Market Research Department of Mars Limited, and Mr Holding is working for the Flying Personnel Research Committee of the Medical Research Council in the Department of Industrial Health, King's College, Newcastle.

INTRODUCTION

THIS study originated from an examination of the design of a new piece of equipment for the Army. Many experiments have been reported which studied speed, accuracy and amplitude of manual point to point movement, but very little information was available which compared the magnitudes of errors of aim (deviations to left or right), with errors of extent (overshooting or undershooting the correct point). If large differences in the two types of error could be demonstrated, the finding would obviously have relevance to industrial manual tasks, such as assembly work, where a revised layout of machine components and materials would demand only those hand movements which tended to generate the type of error whose magnitude was smallest. Similar considerations apply to the design of displays and controls in certain types of Service equipment.

LITERATURE

In general, simple point to point movements have been studied with two ms in view: first, by conventional time and motion study, to combine the minimum wastage of time and effort with maximum accuracy in manually controlled industrial jobs; second, to study at a more fundamental level the nature of the timing of individual movements in such complex skills as tracking (e.g. Ellson, 1949).

The two measures of performance most frequently used have been the timing of the several parts of the movement and the error of movement. From an examination of the literature it seems that when permitted error tolerance has been small necessitating considerable visual control, overall and constituent timing has been the experimental variable. The underlying assumption for this may be that "sooner or later in such visual positioning movements, he gets to his target accurately" (Chapanis, Garner and Morgan, 1949, p. 269). Conversely, with large tolerances and little or no visual control the output has been in terms of accuracy of movement. As Fitts (1954) points out, however, there is a close relationship between speed, amplitude and accuracy and in considering the results of experiments in this field it s obvious that many gaps still remain.

With reference to the relationship between amplitude and duration Barnes (1949) timed the movement of the hand, back and forth, between stops and reported that it took only slightly longer for a distance of fifteen inches than for one of five inches. Bryan (1892) found that tapping rate varied only from 4.6 to 6.0 c.p.s. over an amplitude range of from 1 to 40 mm. Again Freeman (1914) for handwriting and Hartson (1939) for ballistic movements found little variation in duration with changes in amplitude. Slater-Hammel and Brown (1947) divided fast 'visual positioning reactions' into three phases: (a) reaction time, which remained the same regardless of amplitude, (b) primary-movement time, which increased slightly with, but not in proportion to, amplitude, (c) secondary corrective movement time which increased slightly with amplitude up to 10 cms. but remained constant beyond this.

Duration of fluctuations in force while making rapid control movements were recorded on an accelerometer mounted on a long control lever by Taylor and Birmingham (1948). For a 9" movement to the right which lasted for about 0.34 second they found that force was applied in the direction of movement at an increasing rate for 0.07 sec., then it was applied at a decreasing rate for 0.07 sec. This was followed by a braking force applied at an increasing rate for 0.10 sec., and finally at a decreasing rate for the last 0.19 sec. of the response.

The finding that response duration varies little with amplitude is by no means general. Woodworth (1899) examined the relation between speed and accuracy and found that when movements were hurried (less than 0.5 second per movement) responses made with the eyes open were no more accurate than those made with the eyes closed. Furthermore, as Hick and Bates (1950) point out, a quick movement in response to a signal may be practically complete before any subsequent signal can affect it: it may be almost all 'initial impulse'. In this event duration is not likely to be affected by changes in amplitude. This suggests that when precise control of movement is required to achieve a subjectively high level of accuracy the duration of the movement will vary with its amplitude. Experiments by Slater-Hammel and Brown (1947), Craig (1949) and Searle and Taylor (1948) support this hypothesis. Further support comes from studies of cycles of repetitive movements in industry, those parts of the cycle which demand a high level of sensory-motor co-ordination being responsible for the greater proportion of the increase in total cycle duration (Seymour, 1954, Siddall, 1954). Thus Fitts (1954) relating response variability as a function of its amplitude to response variability as a function of its duration, also showed that a positive correlation between amplitude and duration is dependent upon the amount of secondary adjustive movement in the task.

Experimental data on the accuracy of simple point to point movements is rather sparse. Blind positioning reactions were studied by Brown, Knauft and Rosenbaum (1948) and revealed a tendency to undershoot long distances (4 to 15 inches) and to overshoot short distances (1 to 4 inches). Per cent constant error was shown to be inversely related to distance moved as was the relative variability of the error. Absolute variable error increased with distance moved. The severity of the 'range effect', as this form of motor 'regression towards the mean' has come to be called, has been shown by Slack

(1953) to vary positively with the absolute speed of movement. Slack further quotes Ellson to the effect that the absolute size of movement plays a smaller part in generating range errors than the size relative to the previous stimulus.

In addition to over- and under-shooting of the target (errors of extent) there may be errors to either side of the target (errors of aim), and fast movements which allow little time for secondary corrections are likely to generate errors of both kinds. Craik and Vince (unpublished report) studied the accuracy of extent and found errors of from 5 to 9% on the average for hand movements of from 30 to 240 mm. The accuracy of aiming was shown to be important even at the slow rate of movement of 3 centimetres per second by Corrigan and Brogden, (1949). These authors varied the direction of movement and found that linear horizontal movements at 135° and 315° from the frontal plane of the body were made with the greatest accuracy.

The relation between direction and duration of movements has received much attention. Searle and Taylor (1948) found that the highest rates of movement in descending order were left to right, forward away from the body, right to left and backwards towards the body. In the experiments by Slater-Hammel and Brown (1947) it was suggested that left-right movements give shorter primary movement times than do inward-outward movements, but give longer secondary movement times. Chapanis, Garner and Morgan (1949) tentatively conclude that direction does not seem to be an important variable but the fact that flexion movements of the arm are slightly slower than extension movements may be important and should be taken into consideration.

OBJECT OF THE EXPERIMENT

The present experiment was envisaged as a preliminary study to compare the magnitude of errors of extent and errors of aim in simple point to point movements performed at high speed.

APPARATUS AND METHOD

Since immediate results were required for a specific project it was decided to study only a few of the possible variables and to use simple apparatus. Accordingly only one amplitude of 30 cms. was used, but four directions of movement were compared. These were left to right, right to left, forwards away from the body and backwards towards the body. The movements were timed in groups of four, as described below.

The apparatus consisted of a sheet of smooth-surfaced board on to which a sheet of paper measuring 6½ x 13 ins. was clamped by four bulldog clips. A red dot surrounded by a small circle was marked near the bottom centre of the sheet to locate the starting point for the movement, and four red target crosses (length of arms approximately 5 mm) were placed on the arc of an imaginary circle, each 30 cms from the starting point.

The subjects were required to draw four lines in succession to each target with a ball point pen, held upright in the preferred hand. A different target was used for each direction, the board being rotated appropriately after each group of four strokes, and the order of directions was counterbalanced according to a Latin square design. The 48 subjects used were N.C.O.s from 5 Training Battalion R.E.M.E.

The duration of movement was recorded on a Venner Timer, operating on six volts D.C. This was wired in series with the pen holder in which a lightly loaded spring held two contacts apart until the ball-point was placed on the paper. The summed time for four strokes to each target was the measure treated in the results. Errors in millimetres were measured as deviations along the x and y axes; the y axis being the straight line passing through the starting point and target (errors of extent) and the x axis a straight line passing through the target point at 90° to the y axis (errors of aim).

PROCEDURE

The subjects were tested one at a time during two consecutive afternoons. The board was placed in the horizontal plane on a bench directly in front of the subject being tested. The distance from the mid-point of the front of the body to the starting point was approximately five inches, although since Brown, Knauft and Rosenbaum (1948) have shown that accuracy of movement is little affected by distance from the body, this was not rigidly controlled. The subject was told to hold the pen vertically in the preferred hand directly above the starting point. As soon as the experimenter gave the order to start, the pen was to be placed on the starting point and moved in a single sweep, as accurately as possible, to the target, where it was to be lifted from the paper and returned ready for the next movement. Speed and accuracy were both stressed and the subjects were asked not to make corrective movements in any direction. The procedure was then demonstrated and practice given in each direction until the experimenter was satisfied that the subjects knew what was required of them. As soon as the four movements towards a target had been completed, the time was noted and the board was rotated ready for the next four movements in the selected direction.

RESULTS

1. *Errors*

In the analyses of this section errors have been summed algebraically (i.e. accounting for sign) and consequently positive quantities indicate overshooting (extent) and deviations to the right (aim) of the target as seen from the starting point. Bartlett's test of homogeneity was first carried out on the residual variances of the error scores for each direction (aim and extent errors treated separately) and the variances found to be not significantly different.

(a) *Errors of Extent*

The Subjects × Directions interaction is seen to be highly significant, indicating that the differences between the errors for the four directions are not the same for all subjects. In comparison with this interaction, however, the overall level of accuracy of extent did not vary significantly between directions. There is a highly significant difference between subjects. The mean error of $+6.7$ mm with a standard error of 0.49 mm gives a value of t of 13.7 with 141 degrees of freedom, when comparing this mean with zero.

This t value is highly significant ($P << 0.1\%$), there being a significant tendency to overshoot the target.

TABLE 1: ERRORS OF AIM AND EXTENT FOR FOUR DIRECTIONS OF MOVEMENT

		Inwards	Outwards	Right to Left	Left to Right	Mean
Extent	Mean	5.6	7·7	5·4	8.1	6.7
	S.E.	0.98				0.49
Aim	Mean	1.3	0.7	0.7	0.6	0.8
	S.E.	0.48				0.24

Means and standard errors of means in millimetres (192 results/mean). S.E.s are calculated from the Subject × Direction mean square of the analysis of variance.

TABLE 2: ANALYSIS OF VARIANCE OF ERRORS OF EXTENT AND AIMING IN MILLIMETRES

		Extent		Aim	
Source of Variation	D.F.	Mean Square	Significance*	Mean Square	Significance*
Subjects	47	1160.13	$P < 0.1\%$	44·35	Not Sig.
Directions	3	383.06	Not Sig.	21.37	Not Sig.
Subjects × Directions	141	183.82	$P < 0.1\%$	43·34	$P < 0.1\%$
Residual	576	53·37	—	17·31	—
Total	767	—	—	—	—

*Subjects and Directions mean squares are here compared with the Subjects × Directions mean squares.

(b) *Errors of Aim*

A similar analysis was carried out on the errors of aim. Again it is found that there is no significant difference between directions when compared with the Subjects × Directions interaction.

The mean error was +0.8 mm, indicating a tendency to the right of the target in the direction of movement. The standard error of this mean is 0.24, giving a t value of 3·48 with 141 degrees of freedom ($P < 0.1\%$). Hence the mean error is highly significantly different from zero.

(c) *Comparison of errors of Aim and Extent*

The correlation coefficient between errors of extent and errors of aim is —0.03, indicating independence between the errors in the two dimensions. It was hoped to carry out a complete analysis of variance for comparison of errors of aim and extent, but the ratio of the Subjects × Directions mean squares from the two separate analyses of Table 2 is 4·24. This value is highly significant and so a combined analysis could not be conducted. Also, no simple transformation of the data was immediately obvious to allow a combined analysis. The main purpose of the experiment, however, was to compare the magnitudes of the two types of error. As noted previously, the mean error of extent is 6.7 ± 0.49 mm and the mean error of aim 0.8 ± 0.24 mm. Such a difference in means is clearly significant. In fact, using Table 11 of *Biometrika Tables for Statisticians, Volume* 1, the 98% confidence band for the difference in means is from 4.6 to 7.2.

As a measure of the repeatability of the four strokes made by any one subject in any one direction, the standard deviations of the extent errors and aiming errors were calculated. They are 7.3 mm and 4.2 mm respectively, indicating that performance in the extent dimension is less repeatable than in the aiming dimension.

2. *Duration of Movement*

As explained in the sections on Method and Procedure each subject made four strokes in each direction. The duration of the four strokes was summed on the Venner Timer and these times subjected to analysis of variance. This is shown in Table 4 and the corresponding means in Table 3.

TABLE 3: DURATION OF MOVEMENT (PER 4 STROKES) IN EACH DIRECTION

	Inwards	Outwards	Right to Left	Left to Right
Mean	1.81	1.85	1.79	1.60
S.E.	0.051			

Means and standard errors of means in seconds (45 results/mean).

TABLE 4: ANALYSIS OF VARIANCE OF DURATION OF MOVEMENT (PER 4 STROKES) IN SECONDS

Source of Variation	D.F.	Mean Square	Significance
Subjects	44	1.7917	P<0.1%
Directions	3	0.5397	P<1.0%
Subjects × Directions	132	0.1165	—
Total	179	—	—

It will be noticed that the analysis refers to data obtained from only 45 subjects. Due to a defect in the timer circuit, times of movements were not obtained from the remaining three men.

The significant difference between directions is due to the shorter duration of left to right movements as seen in Table 3.

3. *The Relation between Speed and Accuracy*

For investigating the relation between speed and accuracy, the sign of the error was considered to be unimportant, so in this section modulus errors have been correlated with duration of movement. These data are presented in Table 5 where it can be seen that both types of error and time of movement are negatively correlated for each direction. A further test was carried out to determine whether the correlations between duration and errors of extent were significantly different from those between duration and errors of aim. Significance was not found.

TABLE 5: PRODUCT MOMENT CORRELATIONS BETWEEN DURATION OF MOVEMENT (PER 4 STROKES) AND THE TWO TYPES OF MODULUS ERROR

Direction	Time and Aiming Error (r)	Significance	Time and Extent Error (r)	Significance
Inwards	−0.27	Not Sig.	−0.10	Not Sig.
Outwards	−0.52	$P<0.1\%$ H. Sig.	−0.30	$P<5\%$ Sig.
Right to Left	−0.33	$P<5\%$ Sig.	−0.28	Not Sig.
Left to Right	−0.33	$P<5\%$ Sig.	−0.19	Not Sig.
Total	−0.34	$P<0.1\%$ H. Sig.	−0.21	$P<5\%$ Sig.

DISCUSSION

Magnitude of Errors

The main purpose of the experiment was to compare the magnitude of errors of extent with errors of aim in point to point movement carried out at high speed. The large difference in favour of the aiming dimension seemed at first surprising. It had been considered that because corrective movement, in terms of deceleration, must occur if the subject was not going to overshoot to the full extent of his arm movement, the accuracy of extent would be secured at the expense of accuracy of aiming. Again, for aiming no corrective movements were vitally necessary; the subject could take aim and then make no further corrective movements in that dimension. One explanation is in terms of the greater accuracy of interpolation subserved by vertical lines over that by horizontal lines. However, in the present experiment the larger error of extent was found for each direction of movement and this explanation will not suffice, 'extent' being sometimes horizontal and sometimes vertical. For the same reason an explanation in terms of the foreshortening of the visual angle of extent is also untenable. Indeed it may be tentatively concluded that whatever the reason for the difference in accuracy along the two dimensions it cannot be solely the responsibility of the visual monitoring mechanism.

Should this result be confirmed in future experiments it may be of importance for the future design of displays and controls in certain types of equipment. A convenient example is the radar A scan on which the time-base (usually representing range) is displayed as a horizontal line. It is frequently necessary for the operator to move a strobe along this line by means of a handwheel, to locate a particular target. Recently, Siddall (unpublished report) has shown that repositioning a spot of light is perceptually easier and more accurate on a circular time-base than on a horizontal linear time-base. The former display also has advantages over the latter in terms of spatial economy. If the handwheel were to be replaced by a joystick, which could be moved directly to any point on the circular time-base, the task would consist largely of making aiming movements. Errors of extent, which have been shown to be considerably greater, would not occur since the control would be pushed hard against the stop representing the circular time-base. A further advantage might be derived by employing a pencil control rather than a joystick. Hick and Fraser (Unpublished Report) compared these two types of control and found the pencil to be much superior for speed of marking echoes although the advantage was not significant for accuracy. The evidence supporting this suggestion is not crucial and it remains to compare speed and accuracy of positioning on both types of display using handwheels. As was suggested in the Introduction, the application of this finding to certain industrial tasks by causing a re-arranging of the work layout so that movements of extent are controlled by 'stops' might also merit study. Further experiments on free movements of differing amplitudes, with varying error tolerances and speeds are also required.

Constant Errors

There were two types of constant error—overshooting in extent, and deviations to the right in aiming. Overshooting cannot readily be explained in terms of the 'range effect' described earlier in the Literature section, since the present 30 cms movement is relatively large, and prediction would have gone the opposite way. Neither does it appear plausible to explain the overshooting as an effect of speed of movement, since although speed is negatively related to accuracy it is possible to make mistakes in either direction, and a further hypothesis is needed to explain the direction of error. Speed is apparently a necessary, but not a sufficient, condition for overshooting.

It seems likely that the further determinant is a particular mental 'set' induced by the experimental situation and which has been transferred from similar previous situations. This may be regarded as a stereotyped attitude towards goal-seeking tasks which assumes higher reward for having reached the goal and gone beyond it than for having fallen short of it.

Constant errors in aiming were significantly to the right when viewed along the direction of movement. An examination of the individual sheets showed that nearly all lines were very slightly curved, and this suggested that there was a slight tendency for the fore-arms to pivot about the elbow even though the elbow was not resting on the bench. For right-handed subjects, therefore, a slightly curved sweep, which started moving directly towards the target, would end to the right of the target when movement was from left to right or outwards from the body. On the other hand, the sweep would end on the left of the target when movement was from right to left or inwards towards the body. Unfortunately only two left-handed subjects were included so that a comparison is not possible. However, a second less strong factor, a desire to keep the point of the pen unobscured by the wrist, would again cause the sweep to end to the right of the target. If the two factors, elbow-pivoting and keeping the pen-point unobscured by the wrist, were interacting, it would be expected that constant errors for right to left and inwards movements would be smaller than for left to right and outwards movements. An examination of the data shows this to be so; the directions of movement ranked by the magnitude of their summed deviations to the right of the target are: (1) left to right; (2) outwards; (3) inwards; (4) right to left.

Duration of Movement

The duration of movements left to right was significantly less than in the other three directions and this confirms the finding by Searle and Taylor. The figures in Table 3 are means of four movements so that the approximate mean duration per movement for all four directions lies between 0.4 sec. and 0.46 sec.

It might be concluded from Woodworth and the evidence outlined in the Introduction that the movements in this task have a relatively greater component of initial impulse than of secondary adjustive movements. In this case the shorter duration of left to right movements is also in agreement with the findings of Brown *et al.*

Speed and Accuracy

The significant negative correlation between errors and duration of movement was expected. At such high speeds of movement the available time for using feed-back information, which controls accuracy, is obviously limited. Faster speeds would be expected to prevent even more the assimilation of such information, whereas it is self-evident that at very slow speeds the highest degree of accuracy can be attained compatible with the limits set by visual acuity, tremor, size of stylus, etc.

SUMMARY

Many experiments have been performed to study the relations between such variables as speed, accuracy and amplitude of manual point to point movements, but little work has been reported comparing the magnitudes of different types of error when such movements are carried out at a high rate. It is suggested that this could have importance for the future design of displays and controls for certain types of equipment, as well as a possible application to industrial manual tasks.

The object of this experiment was to compare the magnitudes of errors of aim with errors of extent in simple discrete movements carried out at a high rate and in different directions relative to the position of the subject. Forty-eight subjects were required to draw four lines in succession from a starting point to a target as fast as possible. A lower limit to the speed was set by

demonstration and brief training. Four directions of movement were compared; left to right, right to left, outwards from the front of the body and inwards towards the body. Errors in extent and deviations to left and right of the target were recorded as was the duration per four movements.

It was found that:

1. Errors of extent were significantly greater than errors of aim.
2. Constant errors of extent were overshoots and constant errors of aim were deviations to the right of the target.
3. There were no significant differences in accuracy between the four directions of movement.
4. Duration of left to right movements was significantly less than movements in the other three directions.
5. Speed and accuracy were negatively correlated.

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Book Reviews

Influencing Employee Behaviour. By RICHARD P. CALHOON and C. A. KIRKPATRICK. New York and London: McGraw-Hill, 1956. Pp. xiii+312. Price 30*s*.

The authors, one of them significantly enough a professor of marketing, the other a professor of personnel administration, cover such ground as "Influencing employees is your job", "Why employees behave as they do", "How to make your presentation effective", and "Removing resistance and opposition". The techniques of interviewing and effective writing are dealt with and there is a final chapter on "A program of self-improvement".

This is a book of exhortation, not one of fact—there are no references or bibliography—but there is much here that is admirable, humane common sense. The supervisor—at whom the book is primarily directed—really is encouraged to understand his workers, and the difficulty of so doing is not underrated. He must, further, have the best needs of his workers at heart, provide genuine information and stand up for their interests to higher management. But this is by the way, once he understands his men, he can get down to brass tacks and construct his plan of campaign. This is done by "getting his *attention*, arousing his *interest*, stimulating his *desire*, securing his *conviction* or *acceptance*, and, finally, getting *action* from him".

The italics are in the original and give a fair idea of the energy of the style. The same paragraph ends, "these are the same steps used in advertizing, in selling and, indeed, in winning elections to political office".

The whole book, despite its admirable points, has the enthusiasm and defects of the super-salesman ("Influencing employee behaviour is hard work, and it is done against keen and constant competition"). Its love of the chase leads at times to a huge optimism ("How does one *become* and *feel* enthusiastic? Just start *acting* and *appearing* enthusiastic"), but also at times to disingenuousness. What happens if the worker feels happy and does not want his needs, so carefully listed, to be appealed to? You then "have the task of teaching the employee and showing him what he needs. This is not easy". As a last resort, of course, there is always the sack.

ROGER HOLMES

Measurement of Responsibility: A Study of Work, Payment and Individual Capacity. By ELLIOTT JAQUES. London: Tavistock Publications, 1956. Pp. xiii+143. Price 15*s*.

A *plage* near Cannes was probably not a good place to choose for reviewing a book with a title like this. No wonder the exercise was eventually abandoned. However, it lasted three whole days, so well did Dr Jaques stand up to fairly strong competition of various sorts. The fact is that in the new Glacier Metal story—more earthy and less frilly-Freudian than *The Changing Culture of a Factory*—we have a fascinating account of an enterprising attempt to grapple with some wage and salary problems at their roots. After nearly half a century of apprehensive and frowning evasion of such things by psychologists, this is terrific. Or so it seems to the reviewer, who in his appreciation feels almost (but not quite) prepared to forgive Dr Jaques for labelling himself a 'social-analyst'.

The main idea is as well put on the dust-cover as anywhere inside the book. "What is experienced by individuals as level or weight or size of responsibility has been observed to be solely connected with the discretion they are required to exercise in doing their work. It has furthermore been discovered that level of responsibility can be measured objectively and precisely by the maximum span of time during which an individual is expected to exercise discretion on his own account until his use of discretion is subject to review. By using this measurement—which he terms the time-span of discretion—Dr Jaques has noted that individuals carrying the same maximum time-span in their work demand—quite independently—as a fair and just return for their work, precisely the same earnings and the same status, regardless of the type of work concerned. He concludes from these findings that an unrecognised wage and salary structure is operated intuitively in industry."

In three ways the author does himself less than justice. In the first place, he has not set his stage to the best advantage. He could usefully have connected up, in a preliminary, comprehensive, expository sweep, several related problems in this field. 'Responsibility' is not the only factor which commonly rears its head in job-evaluation systems. The difficulties encountered in defining and measuring it are not easily separated from those encountered in dealing with other factors—especially 'skill', 'effort', and 'working conditions'—which Dr Jaques is inclined to push aside. No doubt his answer will be that he pushes them aside deliberately, because he himself doesn't think much of them. But others do, and he would perhaps have given his ideas a better chance of acceptance, if he had been a shade more tolerant of other people's fancies.

Secondly, even in what he has to say about 'responsibility' he pays insufficient attention to the stock things said about it—and about its measurement—by people like Lytle. At times it almost seems that he is quite indifferent to all the argument that has gone on, under this particular heading, in job-evaluation circles. Again he may reply that most of the argument has been fruitless and should be discounted. And again the reviewer would question the wisdom of the attitude he seems to be adopting.

Thirdly, Dr Jaques invites criticism by making round assertions without giving them adequate support. He appears to have been so impressed by the unanimity of his 300 collaborators that he felt it unnecessary to document it properly, or even to probe firmly into its determinants. This was unfortunate, because it seems that the estimates people made of their maximum time-spans were prepared in the course of discussion with him. This may have been the only satisfactory thing to do, but it does make one wonder whether the estimates may not have been strongly affected by Dr Jaques's own ideas and enthusiasms. Indeed, it is reported (page 81) that in the course of a Works Council discussion on the whole business, and on a specific suggestion to let the upshot of the enquiry be known a bit more within the firm, the Managing Director "agreed the coincidence between time-span and salaries, but doubted if there was any coincidence between salaries and the time-spans members might work out for themselves in unscientific calculations".

These are, the reviewer thinks, criticisms which deserve attention. But none of them is unanswerable. Perhaps Dr Jaques will reply to them, and at the same time give us more news of developments. His stimulating line of thought is well worth pursuing. It may do a lot of good to psychology by bringing it a step nearer to the realities of life.

ALEC RODGER

Psychotherapy and Culture Conflict. By GEORGENE SEWARD (with Case Studies by JUDD MARMOR). New York: Ronald Press, 1956. Pp. xii+300. Price $6.00.

This book is predominantly inspired by Freudian psychology. The first three chapters deal with general aspects of psychotherapy and the Freudian background, leading from what might be called the 'Old World' psycho-analysis to that of the 'New World' with Horney, Fromm, Sullivan and Kardiner. It is well known that the change to this 'New World' psychotherapy depended on giving a special emphasis to social and cultural influences upon the individual at all ages, in place of the predominantly biological approach of the Freudians, with their tendency to confine critical influences in the formation of personality to the first five years or so of life, and to special types of clashes such as the Oedipus conflict.

As a work stressing the importance of a proper consideration and understanding of various social and cultural influences in neurosis and psychosis, and of their significance in the process of psychotherapy, the book is excellent. It seems a little surprising, however, that such a book should seem to the author so necessary, because one could not go far in psychotherapy of an analytic kind without meeting the cultural influences she mentions. Her treatment of social class and status, of the problems of colour and the negro, of the feminine 'minority' group, of American culture clashes and the complex position of the Jew in society, are all sympathetic and insightful, and make the book well worth reading. The case histories add to its value.

What will worry many readers is that the author shows the tendency present in all followers of Horney and similar new ways. This tendency is well brought out when she explains, on pp. 10-11, that Malinowski was the first to challenge the 'Oedipal' expectations based on European culture, and, in the Trobriand matriarchal society, showed that 'the little Trobriander grows up to regard his father as a close companion rather than as a formidable rival' because authority is there invested in the maternal uncle—as if the Oedipus complex were necessarily based on or tied to biological paternity! On p. 245, in one of the case studies, it is pointed out that for the Plains Indian the significant relationship is not with his father but with his Guardian Spirit, who comes to him in a vision. In the case being reported we are told that the therapist succeeded in developing a strong identification with the patient's Guardian Spirit and this was the essential transference which operated therapeutically. We are supposed to believe that it had nothing to do with the father!

Perhaps the biggest problem posed by such a book is something like the question whether the hen of cultural influences came before the egg of individual psycho-dynamics. Surely this is a futile question, and it is useless to hypostatise cultural influences at the expense of the importance of individual conflicts and the psycho-dynamics of the individual. What is needed is a balanced interpretation of the complex inter-dependence of culture patterns and individual psycho-dynamics.

R. W. PICKFORD

L'Analyse Factorielle et ses Applications. Paris: Centre National de la Recherche Scientifique, 1956. Pp. 432. Price 1,500 fr.

A five-day colloquium on factor analysis, ably organised by Professor Laugier and M. Reuchlin, was held in the summer of 1955 at the National Centre for Scientific Research in Paris, with expenses generously defrayed by the Rockefeller Foundation. The papers presented, and the discussions that followed, have now been published in full by the Centre itself. Of the nineteen contributors, about half were French; the remainder were drawn from seven other countries. British and American members were agreeably astonished to discover what a vast amount of factorial research is being carried out in France, Sweden, Germany, and even remoter countries.

In his address of welcome, Professor Laugier pointed out that, whereas in other sciences the methodological rule is to vary only one contributing variable at a time, and keep the remainder constant, in the human sciences this is virtually impossible. Hence statistical procedures have to be used in order to cope with a number of variables, all more or less correlated, and all varying simultaneously. The first step is to transform them into independent and uncorrelated components in much the same way as forces are resolved in dynamics, so that in effect each can be rendered constant by mathematical devices instead of by experimental. This is the object of factor analysis.

At the opening session Burt's introductory paper gave 'a historical survey of methods and results'; Thurstone reviewed 'present problems and new methods of factor analysis'; and Piéron examined the 'general problem of the nature of factors in psycho-physiology'. Professor Reuchlin and Madame Bernyer devoted considerable attention to the relative merits of different procedures and reported the results of applying both American and English techniques to the same data: on the whole the general verdict seemed to be that, for the majority of purposes, the English procedure is to be preferred, since it allows for the possibility *both* of a general factor *and* of more specialised components. Most of the later contributions were essentially theoretical, and discussed the apparent structure of the human mind or personality (or some large section of it), in the light of conclusions empirically established. Five papers dealt with practical applications, such as the application of factorial techniques to the perception of spatial relations and to the analysis of the school curriculum and tests of educational achievements.

Professor Piéron drew special attention to the uses of factor analysis as an aid to vocational guidance and selection. In his view, such methods could provide a valuable 'operational procedure' which would greatly aid the determination of the relevant general and special abilities and improve the accuracy with which the occupational efficiency of individuals might be predicted. In the educational guidance of young children the general factor of intelligence is of prime importance; but for purposes of vocational guidance it is essential to include more specialised factors, including not only capacities that are possibly innate, but also personal interests and acquired forms of knowledge and skill. In allocating pupils to appropriate schools or classes, it is no doubt desirable to determine what is the inborn endowment of each: but with older persons whose education is already completed, the distinction between what is innate and what is acquired is not only difficult but irrelevant. Hence for vocational purposes an empirical analysis may have, in Professor Piéron's phrase, a fruitful 'operational' value, "even without waiting for a theoretical interpretation of the factors obtained".

The volume itself is intended primarily for the specialist. But those who wish for an up-to-date discussion of the latest views and problems could scarcely have a better work of reference, provided they are prepared to read it in French.

CYRIL BURT

Annual Review of Psychology, Volume 8, 1957. Edited by P. R. FARNSWORTH. Palo Alto, California: Annual Reviews, 1957. Pp. x+502. Price 60*s*.

Change is in the air. The former editor, the late Dr C. P. Stone, has been replaced by Dr P. R. Farnsworth, who seems to have ideas about reorganising this annual review. The present one is very little different in style from its predecessors, but we are told that the editorial committee will reconsider their 'philosophy' very soon. They ask for suggestions.

One we should like to offer is that the whole thing should be less like a cram-book based largely on the main American journals. As such, it is very good indeed, but the title leads one to expect something more. It is true that, usually, a small part of the book is made up of contributions from abroad. (In the 1957 issue, R. W. Pickford, of Glasgow, does vision; and R. C. Oldfield, of Oxford, does somesthesis.) But, after making this gesture, the editor seems to say to his contributors, Well, we've done our duty by the foreigners, now you can stick to American work. Thus, the educational (R. J. Keller and Mary Corcoran) and social psychology (D. Cartwright) sections, with 131 and 157 references respectively, are seen to be entirely American in their coverage, unless one lets a few references to *Human Relations* count as partly British. The contributor who, after Pickford, seems to come nearest to providing a truly international survey is M. E. Wright, whose chapter on abnormalities of behaviour displays a really conscientious attempt to pull in work done in Canada and Britain. C. W. Eriksen, who writes on personality, goes even farther afield, and refers to investigations carried out in France and Japan, but he does not do it with Wright's thoroughness.

The industrial psychology section is contributed by R. A. Katzell, a staff member of the Richardson, Bellows and Henry firm. It is informative and realistic. It is, however, overweighted with straight description and has not nearly enough criticism in it. The reviewer suspects, from the curious ordering of Katzell's material, that this may be because he himself lacks a firm 'base'. True, he says some sound things at the end about the recent past and immediate future of industrial psychology as a whole; but even here system and punch seem to be wanting. There is far more coherence to be found in the section on individual differences (J. J. Jenkins and D. T. Lykken). Indeed, this is in some ways the best of the lot, though it too is almost entirely American in its sources.

The statistical section (E. F. Gardner) is useful, not least for its brief final comment on non-parametric methods. "The basic issue is not one of evaluating the efficiency of a parametric method in terms of the corresponding method which would be applicable if the variables were normally distributed, but whether the statistic is appropriate for the data and the problem at hand." There seems nothing remarkable about this, but the sentence might well be read by psychologists who are inclined to fritter away their time applying non-parametric methods to data which could and should be treated otherwise; and who should be exercising their minds on some old problems which non-parametric techniques have at last made viable.

If the editorial committee could manage to make their annual review more truly international—not necessarily by having more non-American contributors, but merely by seeing that all their contributors pay more attention to non-American work—they would increase our debt to them. And if at the same time they could encourage more of their authors to be systematically critical, they would increase it still further. If they had any time left over after that, they might take a look at the lower case 's' they use in their index. At least one reader feels inclined to go round the bend every time he looks at it.

ALEC RODGER

The Social Problem of Mental Deficiency. By N. O'CONNOR and J. TIZARD. London: Pergamon Press, 1956. Pp. viii + 182. Price 30*s.*

This book provides a useful summary of the work on mental deficiency carried out during the last few years by the M.R.C. Social Psychiatry Unit under the direction of Professor Aubrey Lewis. The earlier chapters cover the historical background and contemporary organization of the Mental Deficiency Services, together with some account of the incidence and criteria of mental defect. The later chapters are mainly reports of original investigations undertaken by the authors and their colleagues. There are two studies on the prediction of occupational success in defectives (rather negative in outcome) and a number of related studies of occupational training, social adaptation and psychotherapy. Some administrative and legal implications of the findings are adduced and the main conclusions brought together in a final chapter.

The most important upshot of the work is undoubtedly the evidence it provides as to the occupational capacities of the defective. These appear to go far beyond the conventionally accepted limits. Given careful training, appropriate motivation and—above all—plenty of time, it seems that the defective may come to achieve a level of skill comparing very favourably with that of an individual of normal mentality. The authors further point out that neurotic or psychopathic tendencies by no means necessarily preclude some measure of occupational adaptation. Indeed in some cases simple psychotherapy along group lines is reported to have a very fair measure of success.

These findings are not only of great interest in themselves but may also exert a profound influence on ways of thinking about mental deficiency. The engrained fatalism engendered in so many workers by traditional attitudes towards mental defect—reinforced by bigoted psychologists wedded to the I.Q.—will undoubtedly receive a salutary shock. Although the basic social problem of mental defect of course remains, this book gives good hope that something a little more adequate could be done about it.

This is a solid and capable report in the tradition of Sir Cyril Burt. It should certainly be widely read and may well have lasting influence.

O. L. ZANGWILL

Hearing Defects of School Children. By THE SCOTTISH COUNCIL FOR RESEARCH IN EDUCATION. London: University Press, 1956. Pp. x + 114. Price 10*s.* 6*d.*

This book describes a survey carried out by the Scottish Council for Research in Education. It was initiated by a recommendation in *Pupils Who Are Defective in Hearing*, a report of the Advisory Council on Education in Scotland issued in 1950. The survey was limited to the children born in the County of Fife in the year 1940. The hearing of these children was tested, first of all using a screening test known as the Sweep Frequency Method and thereafter those failing in this screening test undergoing a full test to ascertain their threshold of hearing in each ear. In all 4,170 children were tested including 8 who were known to be deaf and who were receiving special education in schools outside Fife.

The aims of the investigation were to establish the incidence of hearing defects in this population, to compare this with the incidence found in other surveys and to try to assess the effect of any hearing defect found on educational achievement. There is a chapter on technical considerations in audiometry. This, in a concise manner and suitable for those with a little knowledge of physics, describes the nature of sound, the units used in testing hearing and some of the tests of hearing commonly used. A disturbing feature reported is the lack of agreement on the determination of the zero of the scale used in the audiometer. Audiometers of different makes may have different zeros depending upon whether an American or British standard has been used in calibration. There were also slight variations between audiometers of the same make.

A method of computing 'percentage of hearing loss' is described. This is a method adopted by the American Medical Association. Thus hearing losses of varying degrees can be compared. Unfortunately a simple index of this kind does not take into account different types of deafness or the slope of the audiogram and therefore it is doubtful whether one can assess reliably the effect of deafness in this way. The method used in this survey was that of sweeping quickly through the frequencies 125, 250, 500, 1,000 2,000, 4,000 and 8,000 cycles per second, although the frequencies 125, 250, 500, 1,000, 2,000 and 4,000 c.p.s. these being the range of frequencies of greatest importance in speech recognition. The intensity level at all frequencies was set at 10 d.b. and each ear was tested in turn. The instructions for the examiner were very carefully thought out.

Five second year Moray House Training College students were selected for training to do the testing, four of whom eventually carried out the testing and one was kept in reserve. The training took several weeks. Once more it is disturbing to find the wide variations in the results obtained by different examiners. Errors of ± 15 d.b. were made in testing thresholds of the same group of children. This is worth noting as it is so often taken for granted that it is a simple matter to test the hearing by using an audiometer.

Of the 4,170 pupils tested, 325 had a hearing defect of whom 9 were attending special schools, eight of these being in schools for the deaf and 316 were in ordinary schools in Fife. Of these, 108 had double ear defects and 217 had single ear defects. Many of these were only very slightly deaf, caused mainly by middle ear conditions and probably variable; 22 could be considered as having an appreciable degree of deafness.

All those found to have any degree of deafness were re-tested after eight months. Only 50 per cent. remained in the same category, but it is interesting to note that the number of those whose hearing improved was almost exactly balanced by the number of those whose hearing deteriorated.

Of 22 children with a hearing loss greater than 35 d.b., only 12 were known to their teachers. This is perhaps surprising to those without daily contact with the problem of deafness. With adults, as with children, there are many who are appreciably deaf and yet this is unknown to those around them. Frequently odd reactions in conversational situations are put down to factors other than deafness, such as rudeness or stupidity.

Intelligence and attainment test results were available and compared with a control group of children without hearing loss. The results indicate that for the children whose hearing defect is over 20 d.b., the pupils were 8 to 9 months' retarded compared with the control group.

From this survey it is recommended, among other things, that periodic audiometric testing should be carried out on each child at least two or three times in his school career, that the educational handicap caused by deafness should be impressed on teachers and that the results of audiometric testing should be available for all children referred for child guidance.

Further lines of research indicated were:

1. The relation between pure tone testing and the ability to learn speech.
2. Improved tests of ability for deaf children.
3. A more precise and objectively determinable classification of children with defective hearing for educational purposes.
4. The variability of hearing defects.

Although this survey was carried out using children as subjects, there are some important points brought to light which are relevant to the adult and his position in the world. These are that deafness is unseen and often unsuspected and therefore its effects are often related to other causes; its variability which leads to confusion; and the most important fact that the importance of training for those carrying out audiometry may not be sufficiently widely realised.

MICHAEL REED

Pattern for the Listening Eye (for Teachers of Lip Reading). By DOROTHY G. CLEGG. London: National Institute for the Deaf, 1956. Pp. iv+124. Price 6*s.*

This book is written for the teacher of lip-reading. It follows *The Listening Eye*, written by the same author, which was directed towards the student of lip-reading. The introduction shows that Mrs Clegg had a sympathetic understanding of what deafness means.

The first part of the book describes a series of twelve lessons which are quite easy to follow. The first lesson begins with a talk on lip-reading. I would have liked to have seen a note here explaining that there will be some who, at first, will not be able to lip-read at all and who will be very deaf, and therefore a prepared script should be given to the students to read and then the talk given, so that all the students will have understood this important part of the first lesson. I would also have liked to have seen emphasised the importance of beginning and ending the lessons with material particularly easy to lip-read. For beginners lip-reading can be very exhausting and depressing, and encouragement is required, particularly at the end of a lesson.

Mrs Clegg explains how to get help at home. This is indeed necessary. Proficiency at lip-reading does not come from twelve lessons given by a teacher. This can only put the student in the way of becoming an able lip-reader. As much, if not more, must come from outside. The important factors are briefly, but well, explained.

This is an excellent book for the purpose for which it was written. That is, for inexperienced teachers and those who require extra material for their lessons. Together with *The Listening Eye* it could be useful for a deaf person who has an interested friend who would be willing to help to teach lip-reading in an area where a teacher of lip-reading is not readily available.

The more experienced teacher would want to use material directly related to the lives of the deaf people being taught, and not ready made material. The second part of the book does appreciate this, and gives suggestions for the build-up of further more advanced lessons.

MICHAEL REED

Industry and Press Relations. By PETER HAYLE. London: Staples Press, 1957. Pp. 142. Price 12*s.* 6*d.*

To those who would welcome publicity for their activities, the results of trying to obtain some of the kind they would like are often disappointing. A Press release containing material of obvious interest thoughtfully prepared to do the editor's job for him gets no attention or is reduced to three bald lines, while some occurrence which one would regard as unremarkable is made the subject of unexpected and misleading comment.

Mr Hayle's book, with its account of how a newspaper office is organised, explains very well the causes of this apparent unpredictability and offers the means of making better use of the Press to the advantage of both sides in the industrial field.

This is an extremely useful book and, if one is left somewhat aghast at the attitude of the Press in certain matters, it is none the less advisable to be forewarned. It will be of exceptional value to the small organisation in which the duties of public relations officer are a part-time job.

G. HUMPHREY SMITH

L'Analyse du Travail: Facteur d'Economie Humaine et de Productivité. By A. OMBREDANE *and* J.-M. FAVERGE. Paris: Presses Universitaires de France, 1955. Pp. iv+236. Price 1,000 fr.

The subject of work, and its demands on human beings, is one still sorely in need of interdisciplinary research. Psychologists have studied some aspects of it, and produced a certain amount of information on occupational classification, job specification, merit rating, and perceptual problems of display; and information from other sources can be found under the headings of work study, time study, job evaluation, ergonomics, operational research and human engineering. But generally speaking, the person who is interested in one aspect is not interested in all, and one feels that there is a need to bring all these aspects together and see how far they are related.

This book is an attempt to do this by gathering individual approaches under one general heading. It is consequently very difficult to translate its title without begging any questions, but it could be said to be about work analysis. After a long introduction by Professor Ombredane, Professor Faverge examines the place of work analysis in selection, allocation, promotion, training, job evaluation, and work layout. He goes on to consider various types of criteria by which the aims of the procedures may be defined, and in terms of which proposed solutions of problems may be evaluated; this consideration includes a discussion of operational research and personnel assessment procedures. He then offers a critique of methods adopted in work analysis, and proposes as a supplement to these methods the language of communications, information theory. The remaining third of the book is devoted to an exposition by both authors of how information theory can contribute to work analysis, and how such an analysis can be carried out. The final chapter deals with normative implications of work analysis.

This is not a book for specialists in the many aspects of science touched upon, but for the social scientist in general. This general reader may find himself somewhat taken aback by the section on information theory, and led to wonder just how far this measurement can go, perhaps even how far it is proper to go. The application of information theory to psychological problems is certainly novel, but with research going on in Cambridge, Birmingham and Oxford into these matters such application is likely to grow in volume.

The reader here should beware of hasty conclusions. The resolve to take measurement as far as it goes is a characteristic of scientific effort and should be encouraged by all scientists; and to object to measurement *in se* argues either a vested interest in the mystery that may be dispelled or a superstitious fear that to be measured is in some way weakening for the subject. Thus, we are told, primitive peoples may refuse to be photographed lest something is taken away from them which their enemies could use against them.

It would be correct, however, to conclude that such measurements may be misused and that the scientist may have to impose his own controls and prevent this; and the humanist reader can safely say that the scientist has a very long way to go before he can claim that the object under examination is 'nothing but' the measurements.

Were this book written in English we should describe it as 'readable'. As it is, its public will be unfortunately restricted to those who know their French. The reviewer noticed only one proof-reading error: he can vouch for it that the British Institute of Management is not located in 'Hell Street'.

DAVID C. DUNCAN

Effective Personnel Selection Procedures. By C. HAROLD STONE *and* WILLIAM E. KENDALL. London: Staples Press, 1957. Pp. x+434. Price 42*s.*

Most of us working in industry would consider the appearance of a title such as *Effective Personnel Selection Procedures* in the Staples list as a matter of some importance. Since the war there have appeared perhaps a dozen books treating the subject in any depth, and the addition of new material would be particularly welcome. At the outset it must be said that this book fails to fulfil its promise. It is a reprint of an American text published last year, and in the course of reading it through twice I noted only one reference to English work—Handyside and Duncan's investigation into group discussion methods among supervisors.

The first third of the book is taken up with such matters as job description, personnel records, and methods of advertising and recruitment (the level at which this is pitched can be demonstrated by a quotation: "If the paper publishes evening and Sunday editions, start with the Friday afternoon edition. Friday, Saturday, and Sunday are best for ads giving only a box number."). A short chapter on preliminary screening makes points for the "reception clerk or junior interviewer" whose function is limited to determining minimum standards; for example, "the fact that the opposite sex is required for the job, evidence of intoxication, expression by the applicant of complete lack of interest in jobs open, and similar factors ". After a rapid glance at the method of multiple cut-off on tests, the book passes to discussion of application blanks, including elementary item weighting. There is a short chapter on physical standards, followed by an equally short chapter on the employment interview which includes the ubiquitous Wonderlic diagnostic form and the Fear and Jordan evaluation form. The authors wisely suggest that stress interviewing should not be used unless the interviewer knows what he is doing, and why.

Rather less than half of the book is taken up with testing. This phase starts with some commonsense remarks on the requisites for a testing programme and, inevitably, the Taylor-Russell tables for the selection ratio appear. To those who work in the sheltered environment of British industry it may come as something of a shock to find that " a scientific selection programme offers the only defence against ' unfair ' charges under the Fair Employment Practices Code". The essential weakness of the book is exposed on page 276 in one and a half lines: "The question ' What test shall I use? ' is best answered by a qualified industrial psychologist." It is in fact directed at the American personnel officer and has little to offer the British psychologist.

Taking it for what it is, the book is commendably positive and free from error. One might not entirely agree with the authors on some points—" for most (clerical) jobs the minimum level of intelligence is about the average mental ability level for the population as a whole ", " trade tests can be developed by the personnel manager for use in his own organisation ", and the stress laid on questionnaires for personality testing. But it is pleasant to find a chapter on employment interviewing starting with the suggestion that the interview is unlikely to be a suitable selection device except under very special conditions.

It is difficult to see why the book has been published in this country. Much of it deals with American personnel practice, and on the topic of selection it offers little that is not already dealt with elsewhere in a more adequate fashion.

A. G. P. ELLIOTT

Co-Responsibility in Industry: Social Justice in Labour-Management Relations. By JEREMIAH NEWMAN; with a Preface by MICHAEL P. FOGARTY. Dublin: Gill, 1955. Pp. xxiii + 187. Price 13*s*. 6*d*.

This book is important to the industrial sociologist only as a clarification of Catholic thought about industrial questions. It is an attempt to evaluate developments in several countries in the light of official Catholic social philosophy, in order to provide guidance to the Catholic employer, particularly in Ireland.

The first chapter is a discussion of the relevant social principles. Employee participation in decision-taking is not, we are told, a right, since the institution of private property is paramount and must be safeguarded, but it may be desirable in terms of social justice, in the interest of the common good. We are warned, however, that co-responsibility is wrong if it "gives control to trade union representatives from outside the industry . . . it must be exercised by owners and workers . . . an anonymous, collective responsibility, which favours the Socialist mentality, is to be avoided".

Succeeding chapters then deal with developments in W. Germany, Belgium, England and the United States. These chapters are not only descriptive, but also outline the conclusions of some of the systematic researches which have been undertaken, although the treatment of the latter in the case of the U.S.A. is weak, and may be due to an anti-union bias. Indeed, although the author endeavours to be objective, there is little that is new in his discussion of these developments apart perhaps from his persistent concern about the dangers of excessive trade union power and influence. The German system of ' co-determination ', he says, gives too much power to the unions—a power which he compares to that of self-recruiting directors! In Belgium, since they choose the candidates for works council elections, "the unions exercise a stranglehold on industry". In his discussion of developments in England, the author appears to favour a complete divorce of consultation from management-union discussions, whilst he advocates an Industry Council Plan for the U.S.A., which would allot no direct representation to unions, since it would "accord with . . . the realities of the American scene". Apart from the evident bias and the practical difficulties involved in all this, the author's basic assumption is probably erroneous. He implies throughout that to give formal representation and responsibility to unions is to increase their power, whereas to preserve their independent bargaining position and to develop a separate system of consultation will have the opposite effect. It is probable, however, that the former effectively clips their wings, especially as their representatives are usually a minority, whilst the latter may reinforce defensive attitudes and encourage the irresponsible exercise of power.

Indeed, in his concluding chapter, Professor Newman is still grappling with the problem of the position of the trade unions. After restating certain well-established conclusions—that there should be arrangements for management-employee discussion at all levels, that legal compulsion is of little value, that there is a need for changes of attitude, that arrangements must be to some extent tailor-made, and so on—he acknowledges the need to reconcile management-union and management-employee relations. "It may well be that time will prove that it is possible to evolve a method whereby direct union representation on works councils will be found satisfactory." In England and America, at any rate, trade unionism is established in most plants and the method has already evolved. Lay representatives or shop stewards exist, and are normally appointed by the employees; moreover, they will also usually be the works councillors, whether so nominated by the unions (rarely) or elected by employees under a system of open elections. The problem is to get the unions (and management) to accord a real measure of responsibility to them at plant level, rather than to seek to replace them by a parallel, and to some extent competing, system of representation. The problem is to reform the unions, not to circumvent them.

W. H. SCOTT

Other Books Received

Industry and Technical Progress: Factors Governing the Speed of Application of Science. By C. F. CARTER and B. R. WILLIAMS. London: Oxford University Press, 1957. Pp. viii+244. Price 25*s.*

Instinct in Man in the Light of Recent Work in Comparative Psychology. By RONALD FLETCHER. London: Allen & Unwin, 1957. Pp. 348. Price. 40*s.*

Man and Automation. By L. LANDON GOODMAN. London: Penguin Books, 1957. Pp. 286. Price 3*s.* 6*d.*

Work Sampling. By ROBERT E. HEILAND and WALLACE J. RICHARDSON. London: McGraw-Hill, 1957. Pp. xii+244. Price 45*s.*

Problems of Work Study. By INDUSTRIAL WELFARE SOCIETY. London: I.W.S., 1957. Pp. 16. Price 1*s.*

Social Casework: a Problem-solving Process. By HELEN HARRIS PERLMAN. Chicago: University Press (London: Cambridge University Press), 1957. Pp. xvi+268. Price 37*s.* 6*d.*

The Tomkins-Horn Picture Arrangement Test. By SILVAN S. TOMKINS and JOHN B. MINER. New York: Springer, 1957. Pp. xvi+384. Price $10.00.

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Applied Statistics (Edinburgh). 1, 1952 +
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Australasian Journal of Psychology and Philosophy. 9, 1931 – 27, 1949.
Australian Journal of Psychology. 1, 1948 +
Berufsberatung und Berufsbildung (Berne). 32, 1947 +
Biotypologie (Paris). 12, 1951 +
Bolletino di Psicologia e Sociologia Applicate (Florence). No. 1, 1954 +
British Journal of Educational Psychology. 1, 1931 + (Lacking 18, no. 2; 19, nos. 1 & 2; 20, no. 1)
British Journal of Industrial Medicine. 2, 1945 +
British Journal of Industrial Safety. No. 1, 1946 + (Lacking Nos. 34-37)
British Journal of Medical Psychology. 1, 1920 +
British Journal of Psychology. 1, 1905 + (Lacking 3, nos. 1 & 2)
British Journal of Sociology. 1, 1950 +
British Journal of Statistical Psychology. 1, 1947 +
Bulletin de l'Institut National d'Etude du Travail et d'Orientation Professionnelle (Paris). 1, 1945 + (New Series)
Bulletin du Centre d'Etudes et Recherches Psychotechniques (Paris). 1, 1952 +
Bulletin of Hygiene (London). 6, 1931 +
Canadian Journal of Psychology. 2, 1948 +
Chronicle of the World Health Organization (Geneva). 4, 1950 +
Contemporary Psychology (Washington). 1, 1956 +
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Educational and Psychological Measurement (Chicago). 6, 1946 +
European Productivity (Paris). No. 4, 1954 +
Harvard Business Review. 16, 1938 + (Lacking 21, no. 3; 22, nos. 3 & 4; 23, nos. 2, 3 & 4)
The Human Factor. *See* Occupational Psychology.
Human Organisation (New York). 9, No. 2, 1950 +
Human Relations (London). 1, 1948 +
Industrial Welfare (London). 32, 1950 +
Industrielle Psychotechnik (Berlin). 1, 1924 – 16, May, 1939.
Industry and Labour (Geneva). 1, 1949 +
International Labour Review (Geneva). 7, 1923 + (Lacking 43, no. 2)
Journal of Abnormal and Social Psychology (Washington). 22, 1927 + (Lacking 36, nos. 1 & 2; 43, no. 3)
Journal of Applied Psychology (Washington). 1, 1917 +
Journal of Consulting Psychology (Washington). 1, 1937 + (Lacking 6, no. 5; 7, no. 1; 9, no. 1; 11, nos. 1 & 2)
Journal of Counseling Psychology (Columbus, Ohio). 3, 1956 +
Journal of Educational Psychology (Washington). 1, 1910 + (Lacking 7, no. 8; 9, nos. 3 & 10; 10, no. 1; 11, nos. 3 & 10; 13, no. 3)
Journal of Educational Research (Bloomington, Ill.). 10, 1924 +
Journal of Experimental Psychology (Washington). 8, 1925 +
Journal of General Psychology (Provincetown, Mass.). 1, 1928 +
Journal of Industrial Hygiene and Toxicology (Baltimore, Md.). 8, 1926 – 23, 1941.
Journal of Personality (Durham, N.C.). 1, 1932 +

Journal of Psychology (Provincetown, Mass.). 1, 1936 +
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Journal of the Institute of the Science of Labour (Tokyo). 30, 1954 +
Journal of the National Institute for Personnel Research (Johannesburg). 1, 1949 +
Journal of the National Institute of Industrial Psychology. *See* Occupational Psychology.
Management Abstracts (London). 1, 1948 +
Management Review (New York). 15, 1926 – 42, 1953.
The Manager (London). 16, 1948 +
Mensch und Arbeit (Vienna). 1, 1948 +
Nordisk Psykologi (Copenhagen). 6, 1954 +
Occupational Psychology (*Formerly* Journal of the N.I.I.P. 1922 to 1931 *and* The Human Factor 1932 to 1937). 1, 1922-23 +
Perceptual and Motor Skills (Grand Forks, N.D.). 7, 1957 +
Personnel (New York). 24, 1948 +
Personnel and Guidance Journal (Washington). 24, 1945 +
Personnel Journal (Swarthmore, Penn.). 1, 1922-23 + (Lacking 14, nos. 2 & 4; 19, no. 4)
Personnel Management (London). 32, 1950 +
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Quarterly Journal of Experimental Psychology (Cambridge). 2, 1950 +
Revista de Psicologia General y Aplicada (Madrid). 1, 1946 +
Revista de Psicologia y Pedagogia Aplicadas (Valencia). 6, No. 11, 1955 +
Revue de Psychologie Appliquée (Paris). 1, 1951 +
Revue Suisse de Psychologie et de Psychologie Appliquée. 13, 1954 +
Tohoku Psychologica Folia (Sendai, Japan). 12, 1950 +
Le Travail Humain (Paris). 1, 1933 – 7, 1939; 10, 1947 +

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Engineering Psychology: A British Psychological Society Symposium

At the 1957 Annual Conference of the British Psychological Society, held at St. Andrews, 28 March to 1 April, a full day was given to this symposium, which had been convened by Dr N. A. B. Wilson, Senior Psychologist to the Admiralty. The chair was taken by Professor Frank A. Geldard, who at the time was Scientific Liaison Officer for Psychology, United States Office of Naval Research, in the United Kingdom. The discussion on the morning papers was opened by Mr Donald Wallis, Principal Psychologist, Admiralty; while that on the afternoon papers was opened by Mr Bernard Ungerson, C.B.E., of the Anne Shaw Organisation. Contributions by Mr C. B. Gibbs and Dr R. Conrad are not reported here, as they are being published elsewhere.

For various reasons, it has been decided to put the chairman's introductory remarks, and the observations of the openers of the discussions, together, and to regard the other contributions as separate papers.

Professor FRANK GELDARD

PSYCHOLOGY, especially in the post-war years, has been enjoying phenomenal growth in England and on the Continent as well as in the United States. In America alone there are perhaps 20,000 people now engaged professionally in psychological pursuits. The American Psychological Association has grown at such a rate that Professor Boring, extrapolating from the growth curves for the Association and for the population as a whole, has come up with the alarming prediction that in the year 2100 the population of psychologists will be coextensive with that of the human race! Then the term 'psychologist' will contain not so much as one bit of information and our descendants will presumably regard the whole concept of behavioral study as of historical interest only.

Meanwhile, still in its expansive phase, psychology's areas of interest are being proliferated and embellished, and the profession is undergoing frequent organizational revolutions. One of the by-products of this not too orderly development is the coming into being of new fields and sub-fields of psychology. This is not simply a process of fractionation, a new emphasis on what has always existed but has been neglected. Instead, it represents new syntheses, new areas of impact on human concerns. In my lifetime two fields of growing importance have appeared on the scene. One is military psychology—yes, I was born before Army Alpha—and the other is a field in part contributory to it, in part generated by a somewhat different set of considerations, the rapidly developing area of engineering psychology. It is in this field that we shall do our prospecting today, touching on only a few of the host of problems it has taken unto itself.

There is a difficulty of thought surrounding new fields, much of it stemming from troubles of terminology. We invent new words and, by proclamation, try to give meaning to them, forgetting that the diffuse and somewhat mysterious social force called 'usage' really determines, in the end, what words will remain in our language and what significances they will bear. The field of 'engineering psychology' (as we shall call it, because the program committee has made a proclamation) is currently bedevilled with language difficulties of this kind. I need not remind you, perhaps, that our field of interest today is also known as human engineering, ergonomics, human factors research, biomechanics, biotechnology, psychotechnology, and applied experimental psychology. Something of its flavour is carried also by such designations as 'systems analysis', 'engineering physiology and anthropology', 'aviation psychology', and 'applied biophysics'.

Along with the terminological worries there are some organisational difficulties. On the one hand, we have the Ergonomics Research Society—I remind you that it will be the eighth annual meeting that some of you will attend at Bristol in a few days—and two recently born American cousins, the Society of Engineering Psychologists—a Division of the American Psychological Association (receiving its charter at Chicago last September)—and the Human Factors Engineering Society, voted into existence in Los Angeles last October. On the other hand, we have some disquietude, not to say angry stirrings, in engineering circles. In response to a paper by George Peters, entitled 'Human Engineering—a new approach to operational design', which was published in the October, 1956, issue of *Mechanical Engineering,* and which urged an interdisciplinary approach to design problems, there appeared a spirited editorial in *Research and Engineering,* in November, 1956, which, under the provocative title of 'Taking human engineering away from us humans', read, in part, as follows:

"But when he (Peters) calls for an organisation of human engineers he is aiding in the 'disintegration' of the engineering profession. Human engineering and any other discipline or technique that broadens an engineer and makes him more aware of the entire problem should be one of the tools of the trade. Setting up a special group of engineers and scientists as human engineers would tend to make the technique a speciality, the secret rite of its devotees."

On the one hand, the engineers point out that 'engineer' is a title which is protected by law and has implications for certification and licensing; it should not be used promiscuously. On the other, people interested in adapting man's equipment, tools, and environment to man's limitations and capacities find themselves, at worst, in an organisational vacuum and, at best, as performers of odd jobs or human do-it-yourself kits.

It is not only terminological and organisational difficulties that confront the human factors specialist. There are some very much more fundamental matters. Some are methodological, others theoretical or philosophic. One very important question, perhaps the most important one, since on its outcome hangs the whole vista of the future for people in this field, might be phrased this way: "Is engineering psychology essentially basic or applied in its outlook?"

The commonest answer you get to this question is that we are dealing here with a technology, with a body of knowledge held together by but a single principle, the principle of utility. Like engineering itself, engineering psychology is held to be oriented exclusively toward practical aims; ultimately its aims are specifiable only in terms of values.

I submit that this may be a common answer but that it is the wrong answer. The starting-point of a particular research in engineering psychology is very often a practical problem, to be sure, but the matters investigated *en route* to a final solution are often of the most basic variety. There is a lot of needless confusion about this business of 'pure *versus* applied science'. The prevailing error is to suppose that the two can stand only in an antithetical relation to each other. In reality, pure and applied science stand on the same continuum, and perhaps only a single attribute separates them. The difference between them is primarily, if not exclusively, a matter of experimental variables and their manipulation. At the 'applied' end of the scale problems are highly specific ones, and one is not permitted to manipulate the vast majority of the identifiable variables. That is the nature of a so-called 'practical' problem. It comes out of a real-life situation; its parameters are fixed. If one manipulates, as independent variables, those factors that are inherent to the situation, one changes the situation and the problem becomes unreal.

At the 'pure' or 'basic' end of the continuum the position is quite different. Here one is at liberty to employ any identifiable and controllable variable as an independent variable in an experiment. The only restrictions are those imposed by the rules of experimental design. There need be no fear that time or effort is being wasted on an unprofitable manipulation. All 'pure' experiments, providing they observe the scientific canons, are equally valuable and equally valueless. Practical value is not a relevant criterion for basic research. Intellectual satisfaction is.

Few people, especially in a new scientific field like engineering psychology, confine their efforts exclusively to one or the other end of the pure-applied continuum. The prevailing pattern—and I personally believe it to be the most exhilarating and rewarding one—is to begin with a practical problem, one of some pith and moment, and let it lead one (as it seems inevitably to do) into a variety of more basic problems on which a host of outcomes depend. This, I submit, is one way of characterising the efforts of the more successful and stimulating of modern research programs. It seems to me to be the pattern into which fall, for example, the efforts of your own pre-eminent psychological workshop, the Cambridge Applied Psychology Research Unit. Indeed, if its title were fully descriptive it ought to read 'Psychological Unit for Basic and Applied Research'.

What, then, should Engineering Psychology of the future look like?

Should it be peopled exclusively by those intent solely in coming up with workable solutions to urgent problems? Should it be a collection of what are generally known in military establishments as 'quick-and-dirty' problems? Are engineering psychologists fated to 'put out fires' ceaselessly? Or should there gradually evolve, as elsewhere in science, a body of fact and theory, ultimately the establishment of a set of principles? I think the latter. At the same time, there are residents of the scientific community with the souls of firemen and firemen with the souls of scientists. It would be strange if the future did not compass a reasonable mixture of basic and applied progress in this field.

It ought not to be surprising, in view of what I have said about the earmarks of Engineering Psychology, that the fare we have before us today ranges in content and emphasis from the practical to the theoretical, from near the applied end of the scale to near the pure end. You will be getting a reasonably representative sample of the field. Indeed, the symposiasts have agreed in advance that there seems to be only a single combining principle at work in the program—all papers fall properly within the confines, as yet only dimly delineated, of Engineering Psychology.

Mr DONALD WALLIS

Discussion of the three morning papers was opened by Mr D. Wallis, of the Senior Psychologist's Department, Admiralty. He prefaced his comments with a tribute to Professor F. Geldard, who was a familiar and highly-respected figure among psychologists in Britain, both for his published work and as Scientific Liaison Officer for the United States Office of Naval Research.

The present symposium was notable in signifying that engineering psychology had now achieved recognition by the British Psychological Society. Although closely affiliated to occupational and experimental psychology, it was distinctively concerned with human factors in the design and operation of machines. As such its progress was conditional upon insight into the nature of skilled behaviour in man-machine systems. The morning session had been devoted to the theoretical bases of this new discipline.

The papers by Dr Kay and Mr Gibbs were presented in terms drawn from what possibly were the two most intriguing and useful theoretical models of behaviour adopted by engineering psychologists. On the one hand we had the human operator regarded conceptually as a link in a communication chain. On the other, he was regarded as a linear component in a servo loop. Both notions were borrowed, of course, from engineers. Nor did one exclude the other. Although the scope of these two models for increasing our knowledge and understanding was at present limited mainly to the area of perceptual-motor skills, they had pragmatic value in applied work. Psychologists could hardly discuss perceptual problems with engineers in terms of 'ego-functions'; but they could get their ideas across by translating them into appropriate engineering analogies.

Referring to the content of these two papers, Mr Wallis drew attention to what he judged to be the highlights. The distinction drawn by Dr Kay between 'knowledge of results' and 'knowledge of performance', for example, was an illuminating one. It had implications both for training of operators, and also for equipment design. With many power-assisted controls, the loss of 'feel'—of proprioceptive feedback—entailed a reduction in the current knowledge of performance. Engineering psychologists had in fact developed ways of modifying such systems in order to compensate the operator for this possible handicap.

Mr Gibbs had argued convincingly for an understanding of serial psychomotor skills through the principles of self-regulating and error-actuated mechanical systems. Learning theory protagonists were clearly faced with a challenge here. Mr Wallis wondered whether experiments on transfer of these skills after training might offer further support for 'servo' type explanations rather than 'associationist'.

Turning then to Dr Baker's paper, Mr Wallis welcomed the demonstration that engineering psychologists were not altogether chary of tackling behavioural problems associated with what used to be called the 'higher mental abilities'. He remarked on the rather subtle difference between 'decision-making' and 'decision-taking', which had been clearly drawn by Dr Baker. Here again, it seemed evident that the subject (or human operator) was being regarded very much as a 'black box'. There were few signs as yet that motivational and personality variables could be handled within the theoretical models on which current engineering psychology studies were based.

Mr BERNARD UNGERSON

Anyone who has to comment in a limited time upon papers as 'meaty' as these, has little opportunity for compliments or for indicating points of agreement. I shall therefore concentrate upon those matters which seem to me to invite critical comment or suggestion. It is therefore only right that I should, at the outset, express my general admiration for the thoroughness of the work reported and the clarity with which it has been set out for us. I shall, by virtue of my own experience and my present occupation, look at the papers from the point of view of one who is a consultant working in, or closely with, industry. That is to say, you can expect from me some of the reactions of the practical man faced with research results. While such a man may, as I do, respect research work and hope for great benefit from it, he must inevitably ask himself all the time whether the cost, in time, money and possible disorganisation, is justified by the benefits which seem likely to result.

First, the paper by Mr Singleton and Mr Simister seems to me to confuse time-study with motion-study and therefore to underestimate what can be achieved by the latter. It is a pity to bring this common confusion out of its usual industrial setting and give it wider circulation among psychologists. The matter is important because, later, I shall suggest that a statistical-research steam-hammer has been used to crack a nut which could have been dealt with more cheaply and quickly by motion-study. But at the outset let me make it clear that I do not agree that the engineering psychologist is, in practice, faced by the dilemma suggested by the writers. They are, by implication, thinking of time-study men, when they use the term 'work-study engineer'. If they appreciated fully the motion-study role of the true work-study specialist, they would see that there is no dilemma, that it is the so-called work-study specialist with a horizon limited to time-study who is unscientific and whose work is the antithesis of scientific research.

The research into the effect of foot controls was thorough but unnecessary. The same conclusions would have emerged with equal certainty and less fuss if the job had been studied by micromotion-study, or even perhaps by means of a two-handed process chart made from a film. Only a small proportion of the elaborately-planned observations would have been necessary to prove that correct conclusions had been drawn.

But perhaps the greatest deficiency of this piece of work lies in the absence of appreciation of the psychological factors involved in such an experimental situation and its resulting changes. The sentence, "If she prefers the old method of working we assume that the machine and not the operator is at fault", suggests that resistance to change is always rational and that beneficial changes are never resisted. Such an assumption is, of course, quite untrue.

It is surprising to read in 1957, "It was only after spending some weeks in this factory that the observers realised that this operator was a member of a closely-knit social group of four machinists. Each member of the group did the same kind of work and was able to assess the weekly wage of each of the others. Their wages were different but there was a convention regulating the extent of this difference. It was concluded that no new machine was likely to change the routine output of any one member of the group. The subject was middle-aged and her wage of about £8 or £9 per week was sufficiently adequate for her needs to remove any incentive to ignore the group and improve her own earnings." I can only suggest that Professor Viteles's *Motivation and Morale* should be made compulsory preliminary reading for anyone wishing to undertake work of this kind. This would make it clear that there is little point in recording time to the nearest second and percentages to two places of decimals in a situation where the operators have a tacit agreement to limit output.

The second case study dealing with the layout of closing-rooms is open to rather different criticism. If we may judge from the film shown with this paper, the job consisted very largely of 'cleaning up' a very badly run and apparently chaotic department. Much of the demonstrated improvement would have been achieved by a first-class foreman who cleared out the rubbish, had the place swept regularly and applied a little common sense. My own experience of the boot and shoe industry leads me to believe that this particular closing-room was well below the average standard and that improvement was therefore very easy to achieve.

Now, 30 years ago, there was perhaps a case for industrial psychologists involving themselves in this kind of project, but there can be little justification for it today. Our job is surely to do, for management, pure and applied research which it cannot do for itself, and not to get involved in foremanship on the shop floor.

As in the previous research, the investigators seem to have failed to see some of the essential elements of their problem, because theirs is basically a time-study approach. For example, they accept, apparently without question, that "a shoe of average complexity goes through more than twenty operations in this room" and begin to measure "the load at each station and the density of traffic between each station". But why twenty stations? Why not ten or thirty? Surely the size of the unit of work, the question whether, on technical and psychological grounds, some of these operations should be combined, is a question which the industrial psychologist should study?

Again, the investigators make assumptions which need justification. For example, they say that "the preparation section is separated from the rest of the room since these operations are essentially different in character". The meaning of "different in character" is far from clear, but assuming it to have some useful meaning, what is the justification for assuming that such a difference justifies separation? After all, a bus driver and bus conductor have jobs which the writers would presumably regard as "different in character", but they work close together for the very good technical reason that the driver's seat and the conductor's platform tend to move through space together. In the same way, in the shoe factory, the easiest and most efficient production may well be achieved by the juxtaposition of a set of widely differing processes.

In general, it is not surprising that the figures for improved output, quoted when this paper was read, fall far short of the 100% increase which, as far as I can judge, from the old-method film, could easily have been achieved.

Mr Seymour's paper seems to me, in its earlier paragraphs, to proceed too easily to generalisation, on comparatively slender evidence. He himself points out that "there is, of course, no proof that results obtained in experiments of verbal, arithmetical or maze learning will necessarily hold for sensori-motor tasks". This seems to imply that we need not worry unduly whether results from one sensori-motor task will apply to other sensori-motor tasks—which is, of course, a very doubtful proposition indeed. He similarly claims that "when a certain level of performance has been attained on the component elements of a task, there is little loss when these are combined into the whole task". He supports this contention with the results of Dr Gagne's experiments (1947) and his own work on training for the capstan lathe (1955), but proceeds to point out that the latter may, for good reasons, not be a true example of transfer. He thus seems to be generalising from very few cases, and those far from clear-cut. He goes on to explain that the point is important "since, without it, the part of isolation methods of training currently used in many industries might be of little value".

I am left with the feeling that his most important basic assumption is relatively ill-founded. It would be as well to remember, the late Dr Myers's insistence that "an organism is more than the sum of its parts", and not to jump too quickly to the conclusion that the superiority of part-training has been established.

Later in Mr Seymour's paper I have some difficulty in following his theoretical argument. This may be, and probably is, due to shortcomings in myself, but I feel fairly sure that any non-psychologist reader will have similar difficulty with such phrases as "a level of behavioural manifestation".

The summarised results of unpublished work in the Department of Engineering Production at Birmingham University are very interesting. They confirm much of what has been assumed, on slender evidence, by motion-study experts in industry and fit in well with the recent findings of Kay and others on the importance of the handling of incoming signals in the development of skills. Some of Mr Seymour's more abstruse reasoning, however, seems to get us little further than the long-held assumption that a working method involving less movement is more effective and more easily learnt. This assumption is common to all those who follow the Gilbreth tradition and to the protagonists of systems of time-study based on predetermined motion times. It would be interesting if Mr Seymour would use the chronocyclegraph in some of his researches, as this recording device would give him valuable information about the path of movement and about what happens during each therblig.

In general, one can only applaud Mr Seymour's view that "we are more likely to learn about transfer by gaining a deeper understanding of skilled performance, than by conducting transfer experiments based on inadequate understanding of the processes whose effects we are comparing". On the other hand there is nothing in this paper to permit a comparison of the effectiveness of part-training and whole-training, especially when we are dealing with skills which do not divide easily and naturally into sub-tasks which are unchanged when assembled into the complete cycle. Until much more of this comparative research is carried out, any predilection for part-training appears to be little more than an act of faith.

Upon Dr Fraser's paper I have less to say, primarily because it deals with problems less familiar to me. I found it difficult to follow his definition of stress and his subsequent discussion. His definition is that stress is "anything which in relatively extreme form tends to disrupt normal functions". The phrase "relatively extreme" could hardly be more hazy, but one can guess what it is intended to convey. However, Dr Fraser himself shoots down the definition when he says a little later, "but it has been shown *repeatedly* that owing partly to the novelty effect of giving a short interpolated test, subjects are often awkward enough to perform better after exposure to stress". Surely, in logic, if stress *repeatedly* fails to produce the results by which it is defined, it cannot be stress according to the definition. If it *is* stress, although performance improves, the definition will not do. The inadequacy of the definition is also suggested when Dr Fraser points out that "knowledge of results tends to stabilise performance under stress".

The statement of general principles governing the effects of stress on human performance would be of great practical interest and value to industry and to designers of machinery and equipment, although they would, of course, be helped much more by some general guidance as to the "certain level" beyond which deterioration of performance is to be expected. The difficulty of doing this in general terms is, of course, considerable, both because stress is the product of a number of variables which will exert different degrees of pressure in different situations, and also because there will be individual differences in susceptibility among workers (as Dr Fraser sees clearly, when he reports stress effects as being greater with older subjects). One other point which emerges from the reported paradoxical results is the need for replication of the kind of work reported in this paper. In this, as in other fields, there is real value, not only in breaking new ground, but in repeating previous experiments in order to check the soundness of their conclusions.

It is not easy to summarise into general conclusions the views which I have formed from these papers, but the following suggestions seem perhaps worth recording. First, there is a danger that some of the work of engineering psychologists may fail to take existing knowledge into account or to use established techniques which could solve problems more quickly and easily. This is important since psychologists must take care to avoid the criticism which has been levelled at some operational-research workers that they "do methods-engineering at twice the price". Secondly, there is some tendency to carry out detailed work based upon doubtful general assumptions. Thirdly, there is a clear need for repeating, time after time, in varied settings, the sort of work reported in these papers, so that the generality of the findings can be established. Lastly, those who work in this field must know about, and take into account, the social psychological factors which may affect human output and attitudes toward change. Without this, we are in danger of moving back toward the pre-Hawthorne era, when much of our work was excessively mechanistic and we failed to understand the true causes of many of the observed changes in output. In spite of these difficulties and drawbacks, however, the papers seem to me to summarise a great deal of useful research which, if not conclusive, at least provides a number of sign-posts towards future progress.

Information Theory in the Understanding of Skills

By HARRY KAY

(Institute of Experimental Psychology, University of Oxford)

THERE are so many ramifications to our subject that I am making no attempt to present the now familiar 'overview' of the field. I have arbitrarily selected one or two issues which seem to me important: there are many others. When a developed method of analysing data is taken over from another discipline it not only allows certain measures to be taken, but somewhat inevitably it carries with it the suggestion as to what is worth measuring. I want to consider how information theory has influenced our thinking about skills, and for this purpose I propose (1) to illustrate what it has to say about (a) perceiving and (b) responding in skilled behaviour —or if you prefer it input and output—and then (2) to examine how this research accords with other findings in the field.

I am limiting my remarks to Shannon's measure of information which concentrates on the probabilities of events. It is a measure of the *amount* of information, technically the negative logarithm of the probability that an event will occur. Less technically it is a measure of *uncertainty*, the less likely an event, the greater being the information it carries. Where two events are equally possible we need one bit (binary unit) of information to decide between them. In fact, appropriately enough one bit of information is what is given to the new mother when she is told the baby is a boy or a girl. When we are discussing a measure of *transmitted information* this is the familiar statistic of the correlation between input and output (cf. G. A. Miller, 1956).

I am not entering into technical discussion as to 'what is information measurement?' or the admissibility of concepts such as 'entropy' and 'channel capacity'. But let it be said at the beginning it is the information theorists themselves who are now most critical of their measures; it is they who have pointed out that there is hardly any situation where amounts of information 'will be the ultimate criterion of performance' (Quastler, 1955); it is they who are sceptical that amount of information does not adequately cope with the problem of discriminability (Crossman, 1955). Nevertheless in many situations information theory may be rightly claimed to provide 'a very good intermediate criterion'.

Let us first consider the position of previous research on skills, say up to 1940. In this field, as in so many psychological areas, we were not short of data. The psychology of human behaviour is often embarrassed by having too much material. What is required is guidance as to what is worth knowing, in other words some theoretical framework. Without this the psychologist is in danger of collecting either the obvious because he can't miss it or the oddity for its eccentricity. In skills traditional research had been primarily interested in the response. We have to go back to Woodworth's monograph (1899) to find him deploring the lack of interest in the response.

Woodworth won his point, and interest in the response was maintained. Of course the response side of a skill is impressive. You can't ignore the K.O. in a boxing match. However, the response is only half the skill and is not enough if we are to understand performance.

When the psychologist began thinking in terms of communication theory he had to consider an external environment generating the signal and recording the response, whilst between them was the human operator providing *the communication channel*. Thus weight was placed on both stimulus and response. This has led to research in which the input side of skills has been carefully analysed. This has coincided in post-war psychology with a marked emphasis upon perceptual learning, etc., which has also played its part, but information theory has notably contributed to this trend in emphasising perception in skills.

In one of Shannon's studies (1951) his subjects were trying to guess the next letter in a sequence of letters which had been selected from English prose passages. The subject was given the *n*-1 letters and then guessed at the *n*th letter. The game can be played in several ways: *e.g.*, a subject can continue to guess until he is right, and he can be given different numbers of preceding letters. Shannon obtained the following results (see G. A. Miller, 1954):

(*n*-1)	1	2	3	4	5	9	14	99
Per cent. Redundancy	15	25	35	33	45	48	48	68

Thus 15 per cent. of the information conveyed by a letter is also contained in the letter immediately preceding it, 25 per cent. in the two preceding letters, and when we have 99 preceding letters well over half of the information in the next letter is redundant.

We may compare this situation with the case of someone trying to estimate the future position of a moving object, say a car or the trajectory of a ball, from a limited observation of its initial stages. If we throw a ball for a young child to catch he is invariably too late in positioning his hands and lets the ball hit him on the chest. We say he doesn't anticipate the flight of the ball; he doesn't know where it will go but only where it is. Let us imagine the situation is such that our adult subject's head is fixed and he can only observe the trajectory of the ball by successive fixations. Thus we have the trajectory divided into a series of segments, which we might think of as events *a, b, c,* and so on. An individual through his experience of watching how objects travel in space learns about the probable order and temporal relations of these events. Thus given events *a, b, c* he predicts the future position; and the skilled person is the one who can predict accurately on the fewest possible initial events. Once this is achieved the remaining events in the series are redundant, or at the most confirmatory. So much for the popular dictum about 'keeping your eye on the ball'.

From this kind of example it can be seen that we are clarifying the meaning of such sayings as the skilled man having 'all the time in the world' and the 'need to anticipate'. The skilled man can appreciate some events more quickly than the unskilled because they are less uncertain for him: they carry less information. And when we turn to events which do not necessarily occur in an invariant sequence we have examples where the skilled performer on a quick appraisal of present events is trying to predict on a probability basis future contingencies. Information theory is not the only statistic to handle this kind of situation but it does it competently enough.

So far we have discussed only the input arising from the *external* environment. But the operator is handling information from a second source, an internal source. This input arises from his own musculature as he carries out a skill. It is clear that the practised operator learns to recognise such signals; they are in fact a form of *knowledge of results* and I should like to consider briefly this aspect of an old psychological topic. It would seem that in manual skills the operator is always receiving signals which give him some knowledge of performance. Knowledge of results is not something which the scientist has ingeniously introduced into the skill, it is something intrinsic to it, and what the trainer aims to achieve when he gives knowledge of results is to add something to those signals which the trainee will normally receive. Knowledge of results will then be *augmented feedback* for the operator.

This may take several forms according to the task and the progress of the operator. In the early stages of learning knowledge of results may serve as directional indicators, identifying difficult signals for the trainee. Some of our experiments with pressure controls bring out that there may arise a most interesting conflict. The trainee may rely too much on the additional indicator, say a light confirming when the correct response is being made. He performs excellently when it is there but he is attending exclusively to the extra indicator and not to the *intrinsic* signal. This gives the trainee better performance during training but a consequent poorer performance once the knowledge of results is withdrawn. This is what R. B. Miller (1953) has called 'action feedback' as against 'learning feedback' where the trainee's performance may not be so spectacular but he is attending to and learning the intrinsic signals of the skill. Our findings would suggest that this is a complex situation, from which we can make as yet no generalisations. But the problem seems to hinge on the relationship between the two incoming streams of information, the internal input arising from the muscular response and the external signal from some imposed criterion. The respective roles of these signals would seem to vary during the course of practice and with the ease or difficulty of the response itself.

So far then we have put the emphasis on the perceptual side of skills and observed that the ability to receive information is the secret of many skilled actions. Ostensibly we witness an economy and uniformity of action but its basis is the expert's ability to handle both the incoming signals from the external and from his own musculature.

We now turn to the measurement of the motor output in skills. It is the case that to date there has been comparatively little measurement of motor output, but there seems no reason in principle why this is so, though it may be difficult. An outstanding example is Fitts' (1954) attempt to measure the information of the action in a simple pin-assembly task. We have carried out assembly experiments similar to those of Fitts, where the apparatus consisted of a row of 8 pins spaced 1½ inches apart. Parallel to this row and 8 inches from it was a second row of 8 holders into which the pins had to be placed. Electrical contact was made when a subject grasped the pin at the end point and when he touched the holder with the pin as he positioned it. Thus we were able to take contact measures of the four elements, grasp, movement loaded, position and movement empty. We also photographed the operation, enabling us to compare the contact and photographic methods of timing.

Fitts had expressed his measure of task difficulty (Id) as follows:

$$\text{Id} = -\log_2 \frac{\text{Ws}}{2\text{A}}$$

where Ws was the position tolerance expressed as the difference in inches between the diameters of the pin and the hole and 2A was twice the amplitude of the movement. By expressing the index of difficulty (Id) over the observed times he obtained a performance index (Ip) in terms of 'bits'

$$\text{Ip} = \frac{\text{Id}}{\text{t}}$$

When we come to use such formulae it is soon apparent that their terms are by no means cut and dried. We might question whether the tolerance is satisfactorily stated in terms of the difference between the diameters of the aperture and the pin, or the rationale of taking *twice* the amplitude as the denominator. Yet using these measures several interesting features emerge. It is clear that the movement times over much of the major part of the arc—15/16ths, in fact—are constant in spite of varying tolerances at the end points. This we might expect if the time for a movement is determined by the amount of information which has to be transmitted in accomplishing the action. Movement time would be proportional to information load. This being so, we should be able to calculate the information involved in the position elements at the varying tolerances and see how far the predicted values square with the observed data. The results suggest that we have a primary movement which is made to an area of about 2 inches diameter, centred upon the actual target. Having reached this target area the secondary movement begins. This agreed well enough with the calculated values which would predict that the tolerance of the primary movement should correspond to twice the apparent amplitude of the secondary movement. We would say that analysis of this kind has shed light upon the older problem of primary and secondary movements in assembly tasks and given us some basis for examining the difficulties which arise in these kinds of responses.

Turning to our present research, we are continuing this measurement of the motor output in some reaction time studies. The attempts of Hick (1952) and Hyman (1953) and Crossman (1953) to measure the information when the number of possible stimuli were varied were outstandingly successful. We are now investigating how far we can make some measurement in reaction time studies where we are using *graded* responses and varying the required tolerances for a particular response pressure. If we are successful we should be able to predict any increases in the reaction times on the basis of the increased information which is being transmitted in the responses.

I have tried to suggest that information theory has provided an elegant measure of both input and output in skilled performance and has enabled us to appreciate more realistically the interdependency within a skill. The human operator is regarded as a limited capacity channel transmitting signals which come both from an external display and from internal sources. We consider such signals as events, and an operator is particularly concerned with learning when and where they are likely to occur. By so doing he materially simplifies the perceptual side of his task for by appreciating the redundancy of some events an operator can receive the same total information from fewer events. This approach deliberately emphasises the perceptual side of skills. One of the main difficulties facing a trainee is often a complex stream of signals occurring so rapidly that it appears wellnigh impossible to distinguish one from the other. The suggestion is that the operator learns that he does not have to pay equal attention to all signals but that some are more significant than others.

But I should now like to take a broader view of the problem in evaluating whether information theory is contributing to an understanding of skills. Today we have many so-called physiological and mathematical models in psychology. There is no point in hopping on to a 'bandwaggon' just because it is creating more dust than another. But on the other hand it is paltry to disdain an approach because it is or has been fashionable. Equally the psychologist in this country is so ready to accept ideas from other disciplines whilst remaining abnormally sensitive of those in his own subject that we might well be suspicious of information theory.

For myself I find this approach is exciting because of the light which it has shed on many older problems and because the results accord well with those from other fields. We now have a whole series of studies which are converging and which do enable us to build up a fairly convincing picture of the kind of system which the skilled operator represents. Where we are dealing with a situation involving perception of stimulus, cortical transmission and motor response, as in the research on single and serial reaction times we have sound evidence of the intermittency or discontinuity of the operator (Davis, 1956, 1957). Here we have the characteristic not only of single channel transmission but of transmission where there is limited channel capacity. The work on binaural stimulation, particularly Broadbent's (1954) ingenious and comic set-up of sending at the same time one message to one and a different message to the other ear suggests the same conclusion—as a system we receive one signal and have to 'store' a second, for the two signals delivered simultaneously are received successively. When we turn to neurological considerations we find Adrian (1954, pp. 239-40) considering the same problem from his stimulation of the auditory nerve of the cat: some messages are selected, some are 'blocked' temporarily.

If then these are basic limitations of an organism, it would have to find some means of 'getting round' or overcoming such constraints and the things which we call skilful would be mainly those examples where the operator achieved this; that is, overcame the apparent basic limitations. In fact we find this is so: anticipation, timing, etc., are the everyday hallmarks of a skill for the 'man in the street'. And even psychologists have long been familiar with the idea that perception is 'of probable things' (James); or, to put it in its modern dress, of shifting the information load by making certain events redundant and processing only key items.

This then seems to me to be something more than providing us with familiar statistics with which to cope with familiar probabilities. So far we have considered how perceptual difficulty increases when events carry an increasing information load. I should like in conclusion to suggest that the future may well find us studying complex situations in which many signals are *correlated* with each other, and where the organism perceives by a rapid analysis of what is and is not *redundant* in the messages from the various senses. Where events are not correlated we know the organism handles them successively, as in the reaction time and auditory examples we have just noted. But where events are correlated I think it is true to say we don't as yet know what happens.

The everyday world as we know it is one in which we receive complex stimulation from several different modalities, as exemplified in the old problems of the stone 'looking hard' or the fire 'looking hot'. When we examine the information from one modality we find for example that movements of the retinal image may have to be co-ordinated with the activity of the ocular-motor system and with postural adjustments. The sum total of this co-ordinated activity is for us to see a stable world and on the grounds of economy it is tempting to believe that the organism learns to correlate signals from these various sources and to assess their redundancy. Given a novel situation, as in the case of the drunken man, some of the information is distorted with the result that the remainder does not match with it and the environment is no longer stable. As learning seems to play a large part in achieving this stability, it is possible that the visual world of the baby may well be more buzzing and confusing than James imagined: it may in fact be less stable. But whatever that may be it would seem a useful suggestion that the organism will quickly match and drop redundant signals. For the complex and correlated stimulation is typical of the world around us and appreciation of its redundancy would seem to be the most economical and likely way for the human system to handle the situation. And of course it is the everyday responses of life, which are taken for granted, which are the basic skills of living.

ACKNOWLEDGMENT

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The Objective Study of Judgment and Decision-Taking

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BEFORE examining some British work in this field I wish to mention briefly the experimental work in the general field of decision-making which has been and is being undertaken in the United States. It is quite different from that being done here.

The most complete bibliography available on decision-making was published early last year by Edwards, working for the United States Air Force. Edwards lists 98 papers, only nine of which were published prior to 1951. The study of decision-making is, indeed, a very fresh one.

These workers have been attempting to determine how persons make decisions involving varying probabilities of success, by asking questions such as the following:

1 Do subjects make decisions consistent with objective models, *i.e.*, consistent with objective probability? If not, can a psychological scale of probabilities be identified?
2 How many failures are necessary before subjects will abandon a simple testable hypothesis?
3 Do subjects have probability preferences, *i.e.*, biases, in the same way that one has number preferences?
4 Can subjects arrange a series of binary symbols in truly random order?
5 Can subjects perceive the statistical structure of a random series of binary symbols?
6 Is there any relation between work probability and speed of recognition?
7 What factors are responsible for the gambler's fallacy?

The tools for these investigations have been varied, including dice-throwing, card games, pin-ball machines, betting at race tracks, pseudo-ESP experiments, and slot machines.

Some conclusions from these studies are, I think, of great interest.

To begin with it has been repeatedly shown that subjects consistently overvalue long-shots and undervalue short-shots. That is, in gambling games psychological probability is greater than mathematical-probability at low probability values, and is exceeded by it at high probability values. Between these two extremes is a point at which psychological and mathematical are equivalent; only here does one receive real value for money. This point has been termed the indifference point, and considerable work has gone into identifying the position of the indifference point in a probability series. It appears that it is very near the geometric mean of the series.

Another conclusion of interest is that when subjects repeatedly fail to confirm a simple hypothesis (*e.g.*, that there is a pea under one of 3 walnut shells) they begin to express doubt about the truth of the hypothesis at the same points at which we statistically express doubt—at the 5% and 1% levels of confidence. That is, the doubt about the truth of an hypothesis in a simple guessing game, as expressed by the median individual, leads to the same result as that based on a rigorous statistical analysis.

Again, it has been demonstrated that subjects do indeed have probability preferences which are not rational when considered in terms of pay-off. In addition, inconsistency trials have been found—a preference of A to B, B to C, and C to A.

Of interest too is the examination of the common statement that mathematically naive persons could not construct a random binary series, as such series would not contain sufficient clustering. This supposition was recently shown to be in error. Related work has investigated subjects' ability to perceive the statistical structure of a sequentially presented random series of binary symbols, say a circle and a cross. In such an experiment the objective probability (relative frequency) can be arbitrarily set at, say, 70/30. Subjects initially begin predicting the next in the series on a 50/50 basis. Soon there is an upwards swing to 70/30, past it, back below it, and finally settling very close to it.

Finally, a word about the gambler's fallacy. I refer here to unsupported convictions about the dependence of chance events: that a long run in black at roulette is believed by many to signify that the probability of a red increases from trial to trial. In guessing-game experiments this phenomenon, called the negative recency effect, appears quite often. In gambling games it doesn't. Thus, one of the interesting and unanswered questions is, When do subjects think successive events are not independent, and when don't they?

Let us come much closer home. At Manchester Professor John Cohen and his associates have been undertaking some extremely interesting work on risk taking. Analogous to the American concepts of subjective and objective probability we have the Manchester concepts of risk and hazard. By risk is meant a person's subjective probability of success concerning a task he is about to attempt. Hazard, on the other hand, refers to the person's actual degree of success on the task, the objective probability of success. For instance, if a man is sure he can swim the Atlantic he is taking no risk, but the hazard would be enormous.

Let us examine the manner in which these concepts are used. A paper recently published investigates the effect of training on bus drivers. Figures 1, 2 and 3, which may be familiar to many of you, tell the story very neatly. It can be seen, first, that the experienced drivers are completely successful in this task, the hazard is less, within a smaller distance between posts through which they were asked to drive—9 feet 3 inches *vs.* 10 feet 6 inches. This result is due, presumably, to their longer training. But, secondly, what of the differences in risk, the estimates of success, between the inexperienced and experienced groups? Here, although the estimates of complete success on the part of the experienced group were closer to actual performance, there are actually more estimates on the part of this group in the region of 'task impossible'. And so, though they are superior bus manipulators they are not better judges of their driving capabilities. The third figure, for an experienced instructor, shows a different picture. He could judge accurately—his risk was much smaller—when he could and could not drive through a given gap. He didn't believe he could navigate an 8 foot 3 inch gap, and he didn't attempt it, but he was involved in no risk with an 8 foot 6 inch gap, and as he succeeded every time there was no hazard. Both the inexperienced and experienced groups underestimated their capabilities when the posts were far apart, and overestimated when they were relatively close. And, as in the American work on gambling, there is an indifference point where the curves cross, indicating that here their risk and hazard, their subjective and objective probabilities, were equivalent.

In other experiments these investigators have shown that there is a significantly greater tendency to underestimate performance—to have a lower risk level—when physical danger is involved than when it is not.

The Manchester people have struck on some very simple and ingenious techniques for measuring physical risk. One technique applied to a very real every-day situation is simply to measure the time which individuals demand before crossing the road in front of approaching traffic. The person, unaware that he is being observed, steps to the edge of the sidewalk, looks up at approaching traffic, and either steps off towards the other side, or waits for a greater 'safe' period. Figure 4 embodies over 1,100 observations on nearly 500 persons. Here we have the range and distribution of the maximum risk-taking levels of what is probably a fairly representative sample of the population.

Work of this nature, and this is but a tiny sample of the Manchester work, could obviously head in a large number of directions, and doubtless these investigators have already decided on general goals. Some questions I personally would ask, however, are as follows:

1 Is the willingness to accept risks a general personality trait, or is 'riskiness' a function of the specific situation? That is, are people who accept risks in one situation the same people who accept risks in another?
2 When we speak of a 'physically risky' person, could it be that his sensory-motor equipment is inferior, or superior, to the norm?
3 Can 'risky' persons be identified by tests not involving risk?
4 Is it possible that 'risky' persons are the same as the so-called 'accident-prone' persons?

Before leaving this subject of risk-taking, or judgment, I should like to point out just one area where engineering psychology might make a contribution. In my country and in the United States there are very few gates at railway crossings; there is merely a sign some distance before the crossing which urges you to 'stop, look, and listen'. An impressive number of graves in the regions of such crossings testify to the fact that 'riskiness' is not exclusively a characteristic of the citizens of the United Kingdom.

In this country it is accepted that there are damned fools driving cars in the vicinities of railroad crossings, and a high price has been paid to save their lives—21,311 gates and 21,311 persons on salary to close and open them.

Why are gates not needed at traffic intersections in cities? Why is a red-green light sufficient? It has been suggested that in the city traffic situation one continually receives reinforcement concerning the possible consequences of driving through red lights. Many, many times, when we stop on the red, traffic moves across our path as a reminder of what *would* have happened had we not stopped. But the ungated railway crossing presents a different situation. We might cross 50 ungated crossings and never see a train. I hypothesise that at our 51st crossing our maximum risk-taking level is much greater, is more 'risky', than it was at the first crossing. This is the gambler's fallacy in a different context, and often fatal.

How can we achieve continual reinforcement at crossings where a train is close? One answer seems very simple. You signpost the crossing, visually and auditorially *only* when a train is imminent. Thus, when the signal is there, there is *always* a train coming. Such an alarm system would, of course, be tripped off by the train itself. This suggestion could, of course, be examined experimentally.

Now let us consider the approach at the Applied Psychology Research Unit in Cambridge, as demonstrated by the recent and continuing work of the Mackworths, and of Conrad. First, we must distinguish between decision-making and decision-taking. The American work I referred to is work on decision-*making*, meaning that one is primarily making decisions concerning the relative merits of various probabilities, as in gambling. These decisions are highly cognitive in nature, and are relatively independent of the stimuli sources and sensory modalities involved.

In decision-*taking*, however, one is concerned with information arriving *via* a finite number of channels, simultaneously or not, and the job is to process this information according to some given rule. For example, one may be asked to indicate every bit of incoming information having such and such a characteristic. Such indication is decision-*taking*, because one figuratively *takes* this bit of information from the finite number presented. Continuous search, then, is an important factor, and the concept of probability does not arise.

Consider a single stream of different symbols moving across the field of view. Always in view, beside the stream, is a stationary symbol; the comparison symbol, if you like. The job is to decide, as each moving symbol passes the comparison symbol, whether it is duplicate of the comparison symbol, or not. In a more complex form of the task subjects can be instructed to indicate the number of features which are common to both the comparison and moving symbols.

This is decision-taking in a single-stream, or more commonly, a single channel situation. If the moving symbols, or signals, are fairly evenly spaced in time, then the average speed at which decisions of similarity or dissimilarity are demanded is a reasonable index of the difficulty of the task.

Now consider a situation when there is not one comparison signal and one stream, but a number of each, the streams all moving at slightly different rates. In such a situation the demands on the subject to take decisions must fluctuate from moment to moment. There will be lulls and then suddenly there may be demands for attention to a large number of signals simultaneously.

What factors determine human limitations in such a situation? This is one of the tasks the Mackworths set themselves. In the specific experiment I refer to the comparison signal was a simplified 'flight plan', composed of 6 discrete symbols. The separate channels, one moving beside each fixed comparison plan, sequentially exposed other flight plans. The task was to state how many discrete symbols were common to the pair of plans. In Figure 5 the correct answer would be two. This shows a single channel system. In the experiment in question up to 12 channels were simultaneously employed.

But first, in such a multi-channel situation with the channels moving at different speeds, the average speed of decisions demanded is a rather meaningless index of task difficulty because of the lulls and spurts. A new index was developed—the index of signal overlap. Consider the three channel situation shown in Figure 6. The moving signals are visible, in this case, for 14 seconds. A overlaps 12 seconds of B and 3 seconds of C. Thus the signal overlap index of A is 15. Similarly, the index for B is 17, and for C is 8.

Figure 7 contrasts the demands of the situation which result when the signal overlap indices have been worked out for 4 and 12 channels, always remembering that the *average* rate of signal appearance has been equated at 10 signals per minute, or one comparison demanded on an average of every six seconds, in each case. It is readily apparent that more channels mean more chance of signal overlap, and, incidentally, more chances of relatively quiet periods.

Figure 8 shows the failure rate (omissions plus errors) as a function of the speed at which decisions were demanded, for any and for few channels. Remember that many and few channels mean great and little signal overlap. Remember, too, that for many channels there was just as much time for taking each decision, on the average, as there was in the case of few channels. It is readily apparent that time per decision, and number of channels *both* affect human capacity to perform this task.

Figure 9 relates, as an example, the percentage of errors to the index of signal overlap, in the case of an eight channel situation. It is obvious that failures are greatest when signal overlap is greatest.

Consider a related experiment. Subjects were confronted with a display like the one in Figure 10. At the top is a three-figure clock, and immediately below is a series of movable counters, labelled A to T. The job was to move each counter from cell to cell down its own column. Along each column there were four three-figure numbers, each three-figure number designating the clock-time at which the counter should reach that particular cell. At regular intervals the clock moved on one digit and ticked loudly as it did. The subject had to give one order for each tick: he called out the letters of the counter he wished to be moved a cell forward, which the experimenter did. The subject was therefore continually searching for the forthcoming objectives in their correct sequence at a speed determined by the speed of the clock, and under a display load determined by the number of columns. More precisely, the subject had to read the clock-time and then to compute the difference between this time and the times given in the various cells. He then discarded all but one as being his immediate objective.

Here are some representative data. Figure 11 shows errors in performance as a function of the numbers of decisions demanded per minute, *i.e.*, as a function of clock speed, for few columns and many. Figure 12 shows display load (number of columns) plotted on the bottom, and again brings out the effect of speed of decisions demanded.

Such studies (and there are several more) probe human limitations in the field of decision-taking. Is there something here of value for the engineering psychologist? The answer is definitely 'yes'. Let me mention but one practical example. For a number of reasons the air traffic control system at London airport is one of the most complex in the world. It reflects great credit on the designers that the maximum capacity for landing aircraft is as high as 20 per hour, or one every three minutes. But a 25% increase is highly desirable. They would like to land 25 per hour. One of the major blocks to such an improvement is a key controller, a highly trained man. He has no radar but he does have in front of him a number of constantly changing cards with symbols on them. His job is to search continuously through this mass of data, take correct decisions, and give orders. When peak pressure obtains this controller is so busy that his relief may have to stand at his shoulder for as long as 25 minutes before he can slip into the seat. Here, indeed, is decision-taking in action, and the near limit of human capacity for errorless performance. Before 25 aircraft per hour can be landed this limit must somehow be raised. This is but a sample of the type of problem often confronting the engineering psychologist. Basically it is a job of measuring human limitations, and, if they are not adequate, *doing* something about it, often by redesigning the sensory environment, the displays. Studies such as I have described are a valuable approach.

Finally, and briefly, I should like to be more 'basic'. Among their writings in this field the Mackworths have said: "It is therefore important to remove from displays all information that is not needed for present action. This implies (a) the removal of past objectives, (b) reducing the number of future objectives as well as (c) the traditional elimination of noise or random information." Such a display they term a 'now' display.

I would make a few points. First, such an approach is a tacit recognition of the fact that human capacity in this field of decision-taking can be appreciably increased only by modifying the way in which information is displayed. Second, there is very little doubt that in situations where history is not needed, a 'now' display would be ideal. A 'now' display is one in which there is only one piece of information, it is immediately and obviously perceived, and the correct response to it is just as obvious. In its absence you do nothing. It is, then, essentially binary. And in its very purest and most ideal form it is not quantitative, but qualitative. It never asks you to compute. Therefore, it seems to me, if we are to improve markedly human decision taking capacity we must search for more qualitative ways of presenting quantitative information, preferably more qualitative binary ways.

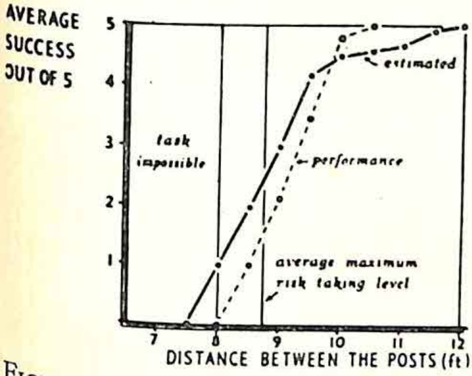


FIGURE 1. Mean estimate of success and actual performance of inexperienced drivers ($n=15$).

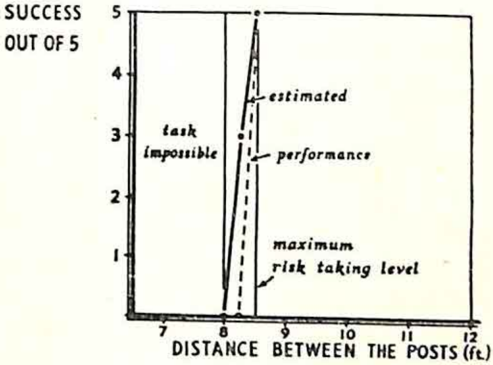


FIGURE 3. An experienced driving instructor.

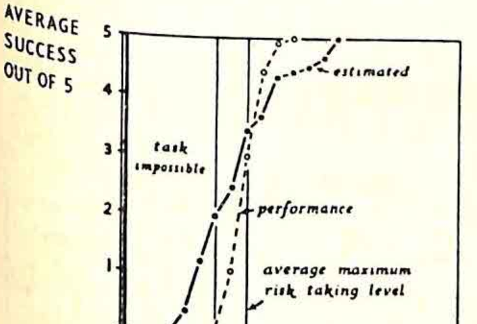
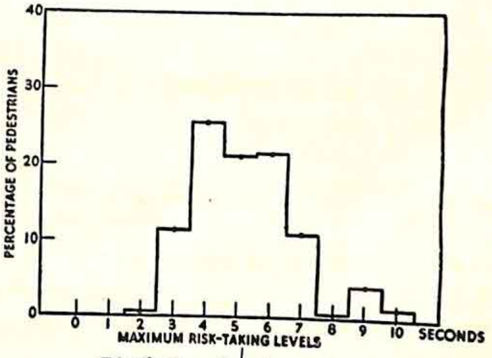


FIGURE 2. Mean estimates of success and actual performance of more experienced drivers ($n=15$).



Distribution of maximum risk-taking levels

FIGURE 4.

ONE DISPLAY WINDOW

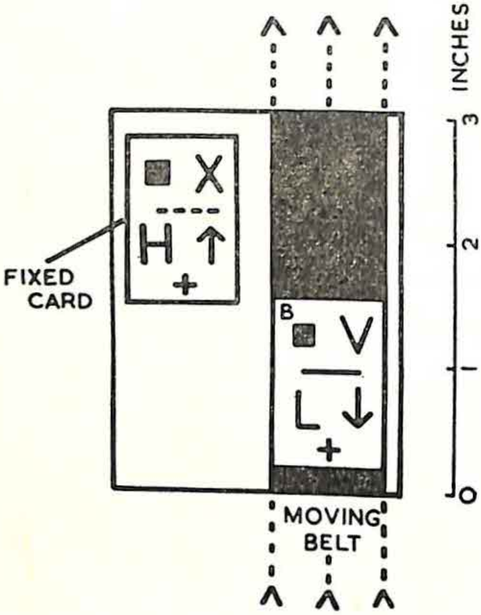


FIGURE 5.

SIGNAL OVERLAP INDEX

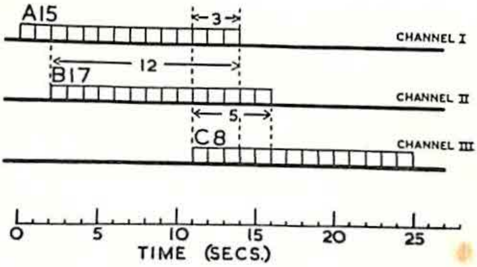


FIGURE 6.

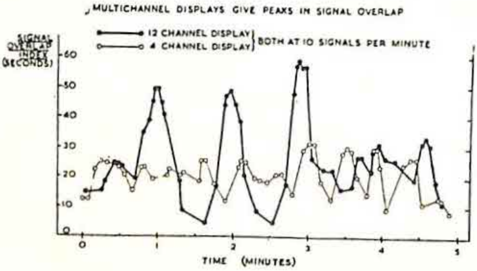


FIGURE 7.

MULTICHANNEL DISPLAYS GIVE MORE FAILURES
FOR A GIVEN LEVEL OF SPEED STRESS

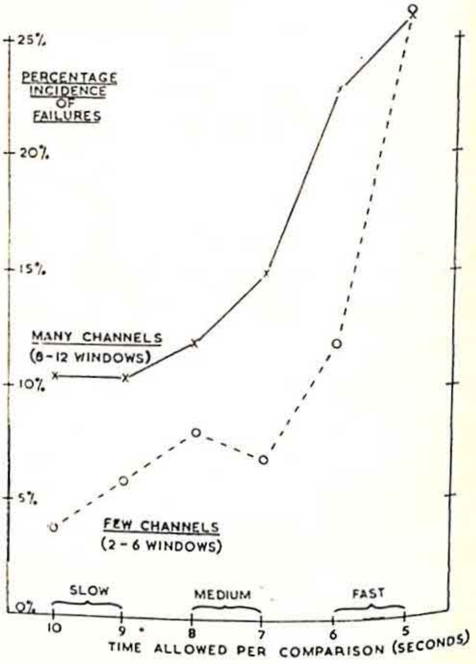


FIGURE 8.

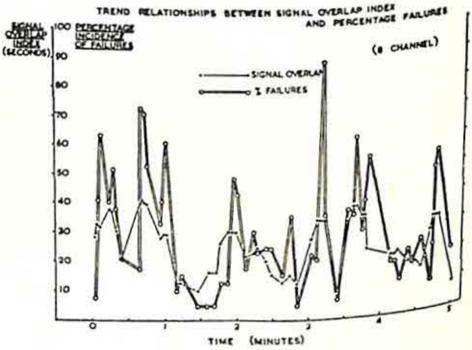


FIGURE 9.

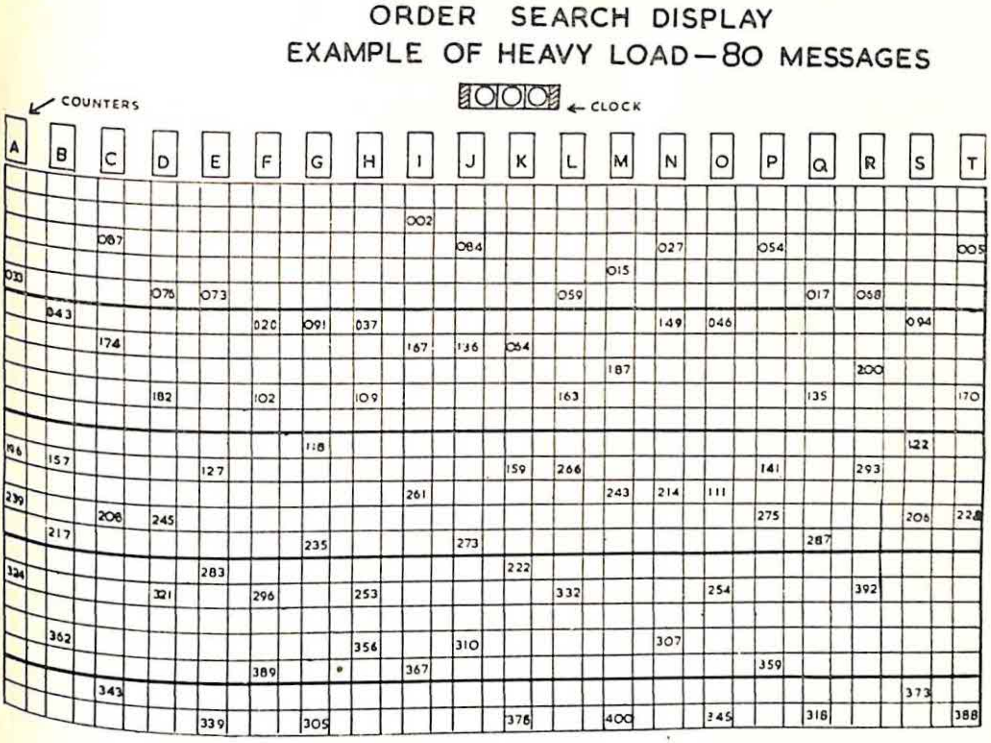


FIGURE 10.

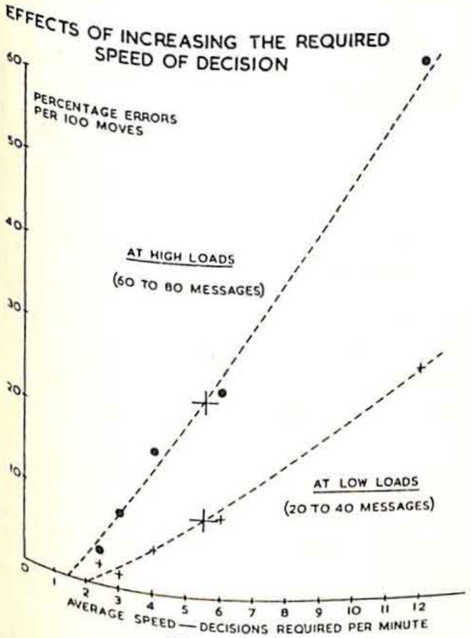


FIGURE 11.

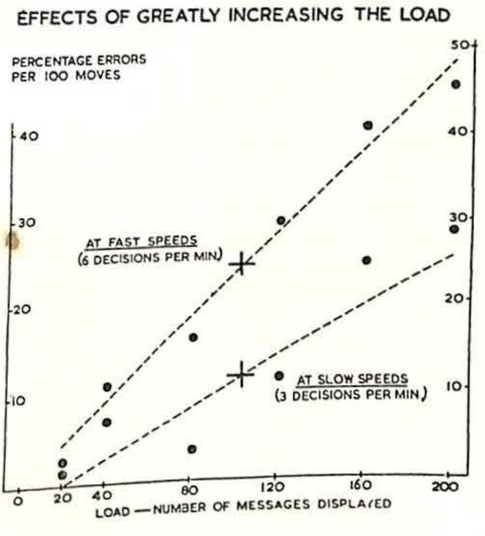


FIGURE 12.

The Design and Layout of Machinery for Industrial Operatives

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INTRODUCTION

THE number of engineering psychologists working specifically in the field described by the above title is quite negligible. We know of four in this country, two in the remainder of Europe and none in America. Since engineering psychology as a branch of ergonomics or human engineering has received considerable publicity from its success when applied to military problems, it is interesting to consider why so few practitioners should be employed on industrial production problems.

The industrialist might reply that he already has many such specialists, but they are called work study engineers, methods study engineers, motion study engineers, and even just industrial engineers. However, these people do not have the same objectives as the engineering psychologist. It seems fair to say that the work study engineer aims to improve industrial productivity, the engineering psychologist aims to improve industrial efficiency. Productivity is measured in units such as output per man-hour. Efficiency is (or at least should be) measured in units which compare the output with the physiological or psychological cost which that output demands of the worker. It must be admitted that we have no comprehensive measure of efficiency defined in this way, whereas the work study engineer claims to have measures of productivity. This reveals another difference between work study and engineering psychology. Work study is a practical activity which has proved its worth to the industrialist, if not the scientist. It has succeeded like politics by being an art of the possible, by measuring what can be measured, and by ignoring, avoiding or making guesses about what cannot be measured easily. For example, if he is employed by a manager who has to fix a standard time on the basis of which a piece-work wage is to be paid, the work study engineer will observe an operator and measure the work cycle time on a stop-watch, he will make an estimate of how hard the man is working and then another estimate of how tiring the task is likely to be over a working day. He will then correct his cycle time on the basis of these estimates and give the manager an answer.

Engineering psychology is a scientific theory which has been successfully applied to the military man-machine system where the stress is high and the economic cost of equipment is of minor importance. There are considerable difficulties in adapting this theory to the industrial situation. For example, if the problem of setting a time standard is given to an engineering psychologist he would, being a good scientist, review the literature and discover that observing operators influences their rate of work, that estimates of working tempo are unreliable and that there is no satisfactory measure of fatigue. The manager would get no answer and would have to make his own guess which would almost certainly be less accurate than that of the work study engineer.

The engineering psychologist who enters industry is immediately faced with a dilemma. He can satisfy his employer by adopting the methods of the work study engineer at the risk of incurring the contempt of his academic colleagues, or he can adhere rigidly to his scientific principles and earn a reputation with his practical colleagues of being a useless theorist.

In this situation compromise appears to be the proper strategy. The following examples, one of machine design and the other of factory layout, illustrate the compromise approach which we have attempted to follow in the shoe industry.

(I) THE EFFECT OF FOOT CONTROLS OF THE NEEDLE ON SEWING UPPER LEATHER

Introduction

One of the characteristics of highly skilled upper leather sewing is that rows of stitching are short and must often be started and ended very precisely. This is particularly true for such operations as fancy stitching and side seaming, e.g. on side seams the average length of a run of stitching is less than one second. Sometimes it would be convenient if the stitching ended with the needle in the leather (for convenience in turning). At other times it would be convenient if the stitching ended with the needle out of the leather. On the orthodox machine these adjustments can only be made by taking the right hand away from the work to turn the balance wheel. Thus the leather position under the needle is effectively controlled only by the left hand at the times when accurate steering and positioning are most necessary.

It seems reasonable, therefore, to consider the possibility of fitting extra foot controls such that the needle can be stopped in the 'up' or 'down' position. It was found that no such controls were manufactured in either Britain or America but that a Danish firm, Rotan, were producing a new transmitter incorporating these features. The control of this transmitter was orthodox in that it consisted of a double foot treadle, which was pressed forwards and downwards to sew and released to stop. The new feature involved additional rotation of the treadle about another axis at right angles to the usual one. To stop with the needle in the 'up' position it was necessary to press downwards on the right heel; stopping in the 'down' position required downwards pressure with the left heel. Several of these transmitters were obtained for experimental purposes.

Procedure

The technique adopted was to measure an operator's performance in the factory, introduce the Rotan in place of her original transmitter and then re-measure the performance. This method is very simple in principle but there are a number of practical difficulties. The more obvious ones, such as obtaining the permission of management to interfere with production, obtaining the consent of the Union to the measurement of operatives' performance, getting the operatives to co-operate, and so on, are relatively easy to deal with by utilising the status of the Research Association. There remain less tractable problems concerned mainly with the validity of the performance measures. From the practical point of view the only measure of direct importance is the time per shoe, since this determines the operator's productivity. This is hardly satisfactory, however, from the scientific point of view since evidence is needed to demonstrate the extent to which any change in productivity is, in fact, due to the new transmitter and not to extraneous variables such as the influence of observers ('Hawthorne effect'), changes in styles of shoe, amount of work available and operator's health.

In order to obtain a variety of evidence, various sources of numerical data were used. Since the operators were on piece-work it was possible to extract the average time per shoe over weekly or longer periods from factory records. A timer using electromagnetic counters energised by a synchronous motor (Singleton, 1954) was used to measure times per shoe over a period of several days, or times per row of stitching over several hours. A tachograph using a D.C. generator to actuate a voltage pen recorder (Denton, 1953) was used to obtain a complete graphical record of machine speed over a period of about half an hour. The 'Setar' (Welford, 1952), an electronic digital recorder, was used to measure the duration of the stops and bursts of stitching. A battery-driven event-counter measured the frequency with which the extra controls were used. After preliminary recordings using these instruments the Rotan was introduced and the operator was allowed to use it for about two months before the validation records were taken. In addition to numerical data, evidence was obtained by taking films and from discussions with the operator.

Results

The change in productivity which occurred after the first introduction of the Rotan was disappointing. It will be seen from Table 1 that the new controls (original Rotan) made little difference to the ordinary working speed, and the tachograph results—which can be regarded as a measure of maximum speed—suggest a considerable deterioration. The change in time per shoe with this method of measurement has been discussed in another paper (Singleton, 1956).

TABLE 1: TIMES PER SHOE (IN SECONDS) BEFORE AND AFTER THE INTRODUCTION OF THE ROTAN TRANSMITTER (SUBJECT AGED 58 YEARS)

	STANDARD	ORIGINAL ROTAN	MODIFIED ROTAN
Factory records over one month	101	106	92
Timer records over several hours	71	72	70
Tachograph records over half an hour	55	62	53

During this experiment the operator was most co-operative and even anxious to produce the results which she imagined we wanted. Thus it seems likely that the Rotan is inferior to the standard motor but that the operator can maintain the same speed by using more effort or concentration. To obtain further evidence to support this hypothesis, measurements were taken of the number of times the machine was started and stopped. Main drive events are the number of starts and stops on bursts of stitching. Auxiliary drive events are the number of times that use is made of the mechanism for putting the needle up or down. The observer was present from 1.30 p.m. to 3.15 p.m., but then left the factory leaving the time recording automatically. He returned at 4 p.m. The results are shown in Table 2.

The overall fall in activity when the observer leaves is not particularly relevant. It is known from other data that performance tends to fall off about 3 p.m. and there may have been changes in the rate of work supply to the operator. The significant point is that activity on the auxiliary drive falls more than does the activity on the main drive. It seems that when the observer is not present she uses the auxiliary drive less frequently. This, of course, is not a criticism of the operator. If she prefers the old method of working we assume that the machine and not the operator is at fault.

TABLE 2: EFFECT OF OBSERVER'S PRESENCE ON OPERATOR'S ACTIVITY

	OBSERVER		% FALL IN ACTIVITY
	PRESENT	ABSENT	
No. of main drive events per hour	996	749	25
% of time spent machining using main drive	29	20	31
No. of auxiliary drive events per hour	359	104	71
% of time spent machining using auxiliary drive	3.95	1.04	74

It was decided that the apparent failure of the new controls might be due to the additional demands which they made on the operator. The runs of stitching are very short yet the operator using the Rotan often has to decide whether to press down with the right heel or the left heel at the end of the row. To determine the relative frequency of these requirements records were taken over two hours of the number of times each heel pressure was used. In this period the operator stopped 'up' 860 times and 'down' 390 times. The ratio of the stops in the up position to the stops in the down position is probably greater than that suggested by the data since the operator sometimes uses the two stops in immediate succession to complete one extra stitch. It seemed that it might be possible to simplify the controls by regarding the stop up position as the normal requirement. The special Rotan treadle which rocked about two axes at right-angles (backwards-forwards for normal sewing, left-right for stop up or down) was removed and the normal backwards-forwards treadle was reintroduced coupled with two small pedals placed beyond the main treadle. The circuit was arranged so that the main treadle was used in the ordinary way with the additional factor that the machine always stopped with the needle in the up position. Of the two auxiliary pedals the left-hand one caused the needle to move into the down position and the right-hand one caused both up and down switches to operate so that the machine stitched slowly but continuously. The machine modified in this way was reintroduced on to the production line using the same operator. Again she was allowed to get used to it for about two months and then further records were taken.

The results are shown in the end column of Table 1. Our own assessment of the validity of these data is that, in terms of ordinary production rate, the modified Rotan and the original Rotan are very little different from the standard machine. In terms of maximum possible rate the modified Rotan is certainly better than the original Rotan and perhaps slightly better than the standard machine. This view correlates with the operator's own opinion. To her the original Rotan was confusing and made her legs ache: the modified Rotan was better than this and somewhat better than the standard drive since it was no longer necessary to touch the hand wheel (which she normally used to turn the needle up or down). She was indifferent, however, when the question arose as to whether she should keep the modified Rotan or return to her old machine.

It was only after spending some weeks in this factory that the observers realised that this operator was a member of a closely-knit social group of four machinists. Each member of the group did the same kind of work and was able to assess the weekly wage of each of the others. Their wages were different but there was a convention regulating the extent of this difference. It was concluded that no new machine was likely to change the routine output of any one member of the group. The subject was middle-aged and her wage of about £8 or £9 per week was sufficiently adequate for her needs to remove any incentive to ignore the group and improve her own earnings.

A second subject in a different factory was selected because she was engaged on the same operation as that utilised on the first investigation; she was much younger than the first subject and worked alone on the operation. The same procedure was followed except that the original Rotan was not used. In this case the introduction of the modified Rotan was followed by a productivity improvement of more than 25%. With this clear-cut difference the data could be examined in more detail in an attempt to determine the locus of the change. The result is summarised briefly in Table 3.

TABLE 3: EFFECT OF INTRODUCTION OF ROTAN ON COMPONENT TIMES OF TASK

EFFECT	EXPLANATION
Machining times for short rows tend to increase	These are the rows where the auxiliary drive is most used. This drive is very slow compared with the main drive.
Machining times for the short pulses to grip the work at the start of the first and second sides tend to decrease.	These pulses need not be of any particular length. The superior acceleration and braking characteristics of the Rotan make it more convenient to make a short pulse.
Machining times for the long rows tend to remain constant or to change only slightly.	There seems to be no reason why these components should change since the time is determined mainly by the necessity for steering and holding the pieces of work together accurately.
All non-machining (*i.e.* work turning) times tend to decrease with some exceptions detailed below.	When the needle has, at the end of each row, already been conveniently set either up or down, the turning is naturally made easier.
The non-machining times which do not change significantly are the time to prepare the shoe, to remove the previous shoe and to re-adjust the grip at the start of the second side.	These are manipulations of work times unconnected with the machine so that there is no reason why they should change when the machine is changed.

Similar investigations were carried out on three subjects in other factories. In every case there was an increase in productivity, although the extent of improvement varied considerably.

The fact that almost all the changes of component times can be explained in terms of known differences between the properties of the two machines is very strong evidence in favour of a conclusion that the difference in total time under the two conditions is, in fact, due to the change of machine. It was concluded that the modified Rotan gives the operator better control of the machine so that the job became easier. How far this resulted in reduced effort and fatigue and/or increased productivity depended on the operator, the factory and the job concerned. Younger operators utilised the new controls more readily than older operators. The new control system is now fitted to all the Rotan transmitters which are sold in this country.

(2) LAYOUT OF CLOSING-ROOMS

Introduction

The closing room is that part of a shoe factory where the input is pieces of leather, fabric or plastic material cut to shape and the output is the completed upper ready to have the sole attached. Most of the equipment in this room is sewing-machines of various types. Early in this century when factory-made shoes were gaining popularity the sewing-machines were arranged on both sides of a long bench. Beneath the bench was a rotating shaft from which power to the machine was transmitted by pulleys, belts and simple clutch and brake mechanisms. This system is still common but since the last war it has gradually been superseded by a system in which each machine is fitted on a separate bench and is driven by its own electric motor and clutch mechanism. This makes it possible to use a small rack system of work transport where the materials move from one operator to another on three-tier trucks rather like tea trolleys.

Procedure

It is necessary to determine how many types of machine and how many of each type are required (a shoe of average complexity goes through more than twenty operations in this room) followed by their optimal positioning in relation to each other and to work entrances and exits. These problems can be settled by determining the load at each station and the density of traffic between the various stations. Techniques of this kind were developed during the war under the heading of Systems Research and were used extensively in the design of Combat Information Centres on warships (see, for example, Chapanis, Garner and Morgan, 1949). The only difference in this case is that we are dealing with the flow of shoe materials instead of the flow of information.

The following are some of the main features considered in replanning a room.

(*a*) Long single or double lines of benches are avoided since, apart from detracting from the appearance (they give what we call the 'tube-station effect'), they inevitably lessen flexibility of movement.

(*b*) Machines are placed in groups, each group performing a series of related or consecutive operations. (There may, of course, be several identical machines in a group, all doing the same job.)

(*c*) The preparation section is separated from the rest of the room since these operations are essentially different in character. One factory using this type of layout has found it convenient to put the preparation section under a separate supervisor.

(*d*) One or more teams may be set up to deal with particular types of work. This enables the operatives to achieve the speed which comes from specialisation and to develop a team spirit. (There are difficulties as well as advantages in this arrangement: it is most likely to be successful in large Closing Rooms.)

(*e*) The number of racks (which limits the work in progress) is decided in accordance with the volume of production required, after taking into account the variety and complexity of styles and the extent to which it is practicable to plan each day's production for balanced loading. Sufficient racks for five days' work is an average requirement.

(*f*) Considerable importance is attached to the colour scheme of the room. A scheme is produced to suit the dimensions of the room, the colour of the equipment, the kind of floor and the lighting.

(*g*) When necessary (and it almost always is necessary) the lighting, both artificial and daylight, is increased in intensity. The window area may be increased, but it is often astonishing to note the difference when existing windows are properly cleaned and kept clean. Care is taken to avoid glare from overhead lighting and all machines are provided with needle lights.

(*h*) The toilets may need to be re-built, and improved cloakroom space with drying facilities provided.

(*i*) Schedules for cleaning and maintenance are prepared. It is not sufficient to repair equipment when it breaks down or to clean the windows, walls and ceiling when the manager happens to notice they are getting dirty. These things are better organised on a routine basis.

Results

Assistance of this kind is also provided by management consultants and by some of the manufacturers of unit benches. The advantage of working from a Research Association is that more time can be spent in assessing the effects of the changes which have taken place.

It has proved surprisingly difficult to measure the change of productivity which occurs. The following measures have been used: (*a*) distance which work travels in the room; (*b*) number of operator hours worked per week; (*c*) number of pairs produced per week; (*d*) average piece-work earnings per hour for certain operators; (*e*) change of earnings for operators transferred from day-work to piece-work; (*f*) cost per pair; (*g*) speed of work as measured by timing instruments; (*h*) pattern of activity using ratio-delay techniques. Most of these are confused by the rapid changes of kind of work which goes through the room. From a number of these studies, however, it is possible to draw a few tentative conclusions. Piece-work earnings for operators who have been working throughout the period are the best measures of productivity. These tend to increase for at least six months after the changeover. The main factor which influences this is the improved method of supply of work, when an operator knows that there is plenty available she works harder than when the supply is limited. From time recordings of performance it seems that increased speed is not due to the more rapid performance of any part of the task but to a general shift of work tempo. Provision of power transmitters which cause the machine to accelerate and brake more rapidly does not in itself make much difference to highly skilled operatives. The provision of improved surroundings by the use of new equipment and colour schemes has its main influence in attracting new labour rather than in speeding up work.

CONCLUSION

Work of this kind must necessarily have a practical bias. In its scientific aspects the work is eclectic in that concepts from experimental psychology, social psychology, physiology, work study and any other discipline are utilised if they can assist in throwing light on any particular problem. It often happens, however, that when a decision is required there is inadequate information available and it would not be economically feasible to stop and acquire the relevant data by experiment or analysis, in such cases a guess is made and the work proceeds. On the other hand all innovations are subjected to validation techniques and at least we have some knowledge of whether or not and sometimes why we have improved on the past situation.

ACKNOWLEDGMENT

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Transfer of Training in Engineering Skills

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THE present disappointing situation in the study of transfer of training was recently summarised very trenchantly by E. G. Chambers (1956). He pointed out that only a small proportion of the hundreds of experiments reported deal with established skills in practical situations, and that the pressing need for creating skills in new industrial and military tasks was inadequately met by laboratory studies, using, for instance, nonsense syllables. "Few," he says, "if any, operatives in industry or in the armed services need to learn words in paired association, or to press one of six buttons when a green light appears at the apex of a triangle." This recent expression of Dr Chambers's views, which one heartily endorses, relieves the necessity for outlining such experimentation as has been undertaken on the transfer of training in engineering and other industrial skills. We may therefore concentrate on reviewing the implications of some recent industrial experiments, suggest lines for future research, and indicate the relevance of our topic to present-day industrial problems.

McGeoch (1952) defines transfer by saying, "Transfer of training occurs whenever the existence of a previously established habit has an influence upon the acquisition, performance or relearning of a second habit". This definition will serve, though for our present purpose we must consider habit as having a restricted connotation. The literature which he proceeds to review is extensive, but out of some two hundred references, only about a dozen deal specifically with sensori-motor skills. (And there is, of course, no proof that results obtained in experiments of verbal, arithmetical or maze learning will necessarily hold for sensori-motor tasks.)

Among the many contradictory results of transfer experiments, one point does seem reasonably established, namely, that when a certain level of performance has been attained on the component elements of a task, there is little loss when these are combined into the whole task. Dr Gagne's experiments (1947) established this point, and in experiments on training for the capstan lathe (Seymour, 1955) the same result was noted. It may well be argued that this is not a true example of transfer, since the component elements and their repetition in the total task are as far as possible identical; but the point is of some practical importance since, without it, the part or isolation methods of training currently used in many industries would be of little value.

In the first capstan experiment (Seymour, 1955), seven subjects practised the task in parts until each attained target levels, which in total amounted to 15 seconds. These parts were successively put together, and the subsequent execution of the total task was achieved in the following times, from which it will be seen that there was little loss of performance on combination.

TABLE I: TIME IN SECONDS FOR FIRST FIVE REPETITIONS OF TOTAL TASK

SUBJECT	1ST	2ND	3RD	4TH	5TH
D.G.	15.1	13.8	13.2	14.3	13.5
C.M.	13.4	14.1	12.4	11.6	13.7
L.B.	16.6	15.0	14.8	14.2	12.6
P.B.	14.7	14.2	14.3	14.7	15.4
J.J.	17.3	—	15.0	16.2	14.1
D.McC.	17.9	21.6	14.7	15.5	14.0
D.M.	13.0	—	15.7	12.5	13.5

Other transfer effects in this experiment, which the subjects repeated after a four month interval, were masked by changes in method of training, and changes in the perceptual stringency of the task.

In the third capstan experiment (Seymour, 1956) two more examples occurred. The turret element was practised by four subjects prior to being performed as part of the total task, and Table 2 shows the average times before and after combination.

TABLE 2: TURRET TIMES BEFORE AND AFTER COMBINATION

SUBJECT AND NUMBER OF CASES	TURRET BY ITSELF AVERAGE TIME IN SECONDS	TURRET AS PART OF TOTAL TASK AVERAGE TIME IN SECONDS
D.H. (8)	23.3	25.2
C.B. (7)	25.4	26.0
A.E. (4)	23.2	20.3
S.N. (5)	35.5	31.1

Five other subjects performed the turret element by itself, then with cross slide element, and then as part of the total task. The times recorded for these stages of combination are shown in Table 3, which again indicates a high degree of transference.

TABLE 3: TURRET TIMES BEFORE AND AFTER COMBINATION

SUBJECT	TURRET BY ITSELF AVERAGE TIME IN SECONDS	TURRET WITH CROSS SLIDE AVERAGE TIME IN SECONDS	TURRET AS PART OF TOTAL TASK AVERAGE TIME IN SECONDS
T.F.	25.5 (4)	26.5 (4)	28.0 (4)
A.S.	25.8 (4)	23.2 (4)	25.5 (2)
K.G.	33.5 (3)	35.0 (3)	35.4 (1)
P.H.	39.9 (4)	40.3 (4)	36.7 (2)
D.N.	31.9 (4)	30.8 (4)	33.9 (2)

To return to transfer of training in its stricter sense, namely as some feature of performance, which, after it has been manifested in one task, can be shown to facilitate the manifestation of that feature in another, different, task. Experiments on transfer of training in industrial skills—and indeed on any perceptual-motor skills—have lacked adequate definition of the skills involved in the two situations between which transfer may be occurring. Such definition demands very precise and complete analysis of the perceptual-motor skills, and it is only recently that techniques of skill analysis have been sufficiently developed to enable us to have any clear idea of the 'from what' and 'to what' that transfer might occur. Only if both the perceptual and spatial characteristics and the level of performance of two perceptual-motor activities are known is it possible to say how much has been transferred from what to what.

It would not appear very satisfactory, therefore, to consider training—or skill—as an entity which can be transferred from one situation to another, as an umpire transfers his pebbles from one pocket to another. Skill is more usefully regarded as a level of behavioural manifestation, the stages towards which—together with the purposive activities which give rise to them—can be regarded as training. If skill and training are regarded as qualities rather than as entities, then what appears to us as transfer of training may in fact be the accidental possession of such a quality and not the transfer of an entity.

So this concept of transfer of training, hallowed though it be in classical psychology, may not be very helpful at any rate in considerations of engineering and other industrial skills. But such a remark is itself not very helpful unless we can gain from it some further insight into the fundamental problems of skilled performance. (And here one would again bear in mind the point made more than twenty years ago by Cox (1934) that there is little evidence for transfer of *practice* between tasks, though some for the transfer of *training, i.e.,* an understanding of 'how' the 'what' is being achieved.)

Recent, and still unpublished, experiments in the Department of Engineering Production at Birmingham University have thrown some light on the changes in human performance that occur with improvements in skill. The task selected was from engineering assembly work, and consisted of *Reaching* a given distance for a component, *Grasping* it from a counterbalanced hopper, *Moving* it to a given position, and *Positioning* it on three pegs. The four elements, or 'therbligs', of this task are common to all assembly work, and to many machine jobs. The component was part of a motor-car electrical equipment, and the operation, which in the experiment could be repeated ten times without interruption, was similar to that performed in industry, though there it is performed as part of a larger task.

Many thousands of recordings were made of the time taken by different subjects to perform each of the four therbligs while doing the task as fast as possible. Briefly, the results indicate:

(1) that although anyone can do the task, inexperienced subjects could not, after even ten half-hour periods of practice, attain the overall speed of experienced factory workers;

(2) that performance was improved, not by a steady reduction in all therblig times, but by a less frequent occurrence of long therblig times;

(3) that improvements in the Grasp and Position therbligs—which involve more perception—contributed most to over-all improvement.

groups, and it is suggested that the criterion of energy-consumption is internally recognised and related to the particular *method* of muscular-group innervation which has been employed. The wide variety of muscular movements available to a subject imposes the necessity of selecting certain muscle groups, and the results reported to be in line with such a selection procedure—at first random, but, with practice, attaining more and more consistent repetition.

If, then, the human operator were able to judge the energy consumption of the 'method' employed to perform a therblig, and to relate this by trial and error to the particular muscle-group innervated, he would be equipped with just such a technique as could give rise to the observed results. The choice of particular muscle groups for innervation and action would depend initially on previous experience, but could be modified and adapted in the light of results achieved and internally recognised.

What bearing, then, have these considerations on transfer of training? First, that if performance on sensori-motor tasks improves in this way, then 'training' on any one task may transfer to another in terms of an enhanced capacity for more frequent selection of the most appropriate muscle groups for innervation, and that this might more properly be called transfer of selectivity than transfer of training. Second—and this is the essential point one wishes to make—that if the acquisition of skill proceeds in this way, then we are more likely to learn about transfer by gaining a deeper understanding of skilled performance, than by conducting transfer experiments based on inadequate understanding of the processes whose effects we are comparing. Indeed, unless we more fully comprehend the nature and acquisition of industrial skills, we are unlikely to gain greatly from experiments directly concerned with transfer of training in engineering skills. Lastly, one may add that the practical problems to be solved are numerous and inescapable. The rapid changes both of fashion and of technology make it necessary for more and more people to change their jobs more and more frequently. Though the changes may sometimes be small, they have a disproportionate effect on performance, production and earnings. The introduction of systematic training on 'part' or 'isolation' methods has, in numerous instances, enabled workers to make these changes more rapidly, for example in garment making and in engineering. But, as psychologists, we are still failing to make an adequate contribution to the solution of the practical problems that surround us in this field.

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Fumbles occurred frequently in these therbligs, and improvement came by a reduction of fumbles as well as by a reduction of duration of fumble-free repetitions;

(4) that improvements in the therbligs arose by a more frequent achievement of shorter times and a consequent 'shift' in the distribution of times.

These features inevitably give rise to the question, how is the subject enabled to improve performance by achieving short times more frequently, and long ones less frequently? The process must necessarily be one of selection[*], but the means of selection and its basis are not clear. External knowledge of results, which in other circumstances may be a basis for selecting particular responses, would not seem to apply in a task such as this. Subjects were informed at the end of each 40 therbligs the time they had taken, but it would appear unreasonable to suppose that this external information provided any clue to therblig times themselves.

The selection process has something in common with that of natural selection, at least in so far as greater 'improvability' is associated with greater variability. This in turn would presuppose some *internal* knowledge of results—some recognition of certain attempts being more successful than others. The existence of such a selection process presupposes two things:

(*a*) a criterion for judging attempts;

(*b*) a means of relating the evaluation of attempts with the way by which they are achieved.

It would appear that any criterion under (*a*) must be internal. The human operator may possess means for timing very short events, but there would not appear to be any short-term periodicity within bodily functions for time judgments within the range 10-50 hundredths of a second.

If the criterion is not time-based, it may nevertheless be linked with the means of performance. Although higher speeds of performance are traditionally associated with greater effort, there is no proof of this (*e.g.*, experienced subjects showed no greater sign of effort when working more quickly, and they appeared to use less effort than inexperienced subjects performing more slowly). It is suggested therefore that the subjects' criterion of achievement and selection may be based not on time but on energy expenditure, *i.e.*, the attempts giving rise to shorter therblig times may be recognised through their involving *less*, not *more*, activity. Determination on this basis would fall into two main phases—success or failure (as denoted by fumbles, which are failures and involve double activity in repetition) and energy-consumption on fumble-free performances. The former phase is not difficult to justify; the latter involves the subject's being able to recognise in some way the energy consumed in accomplishing a therblig.

As stated in (*b*) above, the evaluation by any criterion must also be related to the way in which a given result was attained. All therbligs are performed as a result of muscular contractions achieved by innervation of certain muscle

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[*] A point originally made by Dr E. R. F. W. Crossman in 'Practice and Speed in Manual Skills', a paper to the Experimental Psychology Group, July 11th, 1956.

Environmental Stress and Its Effect on Performance

By D. C. FRASER

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DEFINITION in psychology is a curious thing. One clear point which emerges out of Bartley and Chute's treatise on fatigue and impairment in Man is that 'fatigue' has been over-defined. 'Stress' on the other hand has scarcely been examined at all by any of the users of the term. There is a tendency to assume that everyone knows what it means. This tendency is certainly aided by the difficulty of pinning the term down. Some physiologists would like to identify the term 'stress' with the appearance of a well defined pattern of glandular and chemical changes in the body. This seems fair enough if it can be shown that this pattern arises regularly and reproducibly under a given set of environmental conditions. I do not think the evidence so far justifies such a conclusion. How are we to make any sense out of the term? It is legitimate, I think, to assume that certain extreme conditions are likely to disrupt normal functioning. We know, for example, that continued exposure to an ambient temperature of 100 deg. F (saturated) with an effective air movement of 150 ft./minute, coupled with an energy expenditure of 250 Kcal/m/hr. will produce considerable changes in blood pressure, rectal temperature, pulse rate, and will be accompanied by subjective effects of dizziness, nausea, shortness of breath and other feelings of disturbance, and that after perhaps 30 minutes of such exposure many subjects will collapse.

In 1953 I proposed (and I am indebted to Sir Frederic Bartlett for clarifying the exact wording) that the term 'stress' should be applied to anything which in relatively extreme form tends to disrupt normal functioning. In any experimental situation it is necessary to show that the 'stress' conditions are liable to produce deterioration of performance; such deterioration need not necessarily occur on any given occasion but there must be a significant probability of its occurrence. In general, we are usually interested in the degree of deterioration in performance likely to be produced by 'stress', but even where it can be shown that such deterioration is likely to occur, systematic measurement of the effects of stress presents certain special problems. To choose a well-known example, experimenters have repeatedly tried to find a simple short test which could be given to subjects who have undergone some form of stress and which would indicate quantitatively the degree of impairment of performance induced by the stress. But it has been shown repeatedly that owing partly to the novelty effect of giving a short interpolated test, subjects are often awkward enough to perform better after exposure to stress.

As a result of continued research on the measurement of the evidence of stress we are coming to realise that a satisfactory interpolated test for effects of stress is difficult to achieve, but probably involves at least these three characteristics.

(a) In view of the fruitless results obtained from simple measures of isolated function the test itself should involve continuous serial performance.

(b) The conditions of application of the test should be such as to render it a stress condition; *e.g.,* it should be applied at such a speed, with such a load or for such a duration, that we would expect a deterioration to appear on the task itself.

(c) In view of the clear evidence that knowledge of results tends to stabilize performance under stress, the test should involve a minimum of such knowledge.

Several such tests have been devised, but even with these it is usually better to administer the test as an integral part of the total stress situation rather than as an interpolated test. Using such measures, then, it has proved possible to show reproducible effects on performance of temperature, humidity, hard physical work, ambient noise, and sleep deprivation.

Before going on to discuss the experiments themselves it may be worthwhile trying to sketch some kind of systematic framework. In 1951 I set out some general principles governing the effects of stress on human performance. The most relevant of these are:

(a) The effect of increasing stress beyond a certain level is to produce increased deterioration in performance, the falling-off being roughly proportional to the increase of stress. A simple mathematical relationship can be found between the degree of stress and the falling-off in performance in several types of stress conditions (Mackworth, 1950).

(b) The effect of stress on performance is a differential one, the performance of the less skilled subjects deteriorating much more rapidly than that of the more skilled subjects. (In other words, if we plot impairment of performance against degree of stress, the curves of the less skilled subjects slope earlier and more steeply.) This, of course, implies some criterion to indicate a subject's degree of skill, which has to be worked out for any experimental situation.

(c) A general effect of stress beyond a certain level is to produce increased variability of performance. The less skilled subjects again tend to show this increased variability more.

(d) The effect of a stress condition is to a considerable degree dependent on the knowledge of results or knowledge of performance available to the operator. In general, the more complete, the more precise, the more immediate the knowledge of results the less the performance is adversely affected by a stress condition.

Let us consider first of all some effects of noise on visual performance. Much earlier work showed no very consistent effects of noise on performance beyond the initial disturbance produced by startling noises. But, as Broadbent points out, the tasks used may not have been particularly suitable in view of the fact that they did not take sufficient account of task difficulty, individual differences, effects of prolonged performance, and used overall rather than analytic scores.

In a series of experiments using two vigilance tasks, Broadbent found that subjects showed impaired performance when watch-keeping on a display made up of steam-pressure gauges in 100 db. noise as compared with 70 db. On an easier task of watch-keeping on a display made up of small lights, another group of subjects showed no overall effect of noise, although certain subjects who showed a practice effect on this task also showed an impairment effect of noise. The first slide shows the pattern effect as an index of 'fatiguability'. He has found it possible to correlate such improvement effects with independent personality tests and with certain key factors in the life-histories of his subjects. The possibility of isolating the fatiguable goats from the alert sheep by means of a vigilance task is an attractive one, but of course it is a long step from a laboratory task to a personality inventory, and Broadbent would certainly be the first to recommend caution in such an extrapolation. This experiment does show up neatly some of the principles I have already put forward—the importance of continued performance, long duration, reduced knowledge of performance, and differential effects of stress.

Now let us consider another ingenious experiment of Broadbent's. He set his subjects a mental arithmetic task, in which part of the information was removed sequentially. For example, the subject might be presented with a six-digit number; on pressing a button this number disappeared, and was followed by another number. The subject then has to subtract the second number from the first. Unlike most mental arithmetic tasks, which do not show a deterioration effect under noise, the subject therefore has to hold a certain amount of material in his memory. Broadbent found that with this task the subjects show a significant slowing down under noise conditions as compared with quiet conditions.

Another interesting result in this series of experiments indicates a carry-over effect of noise. One group of subjects was tested twice, both in quiet conditions; another group of subjects was similarly tested, first under noise, then in quiet conditions. The second score under quiet conditions was different from the initial score, and worse for the group which was originally tested under noise. This carry-over effect (which lasted for twenty-four hours) of noise is particularly interesting in view of the delayed recovery effects of heat stress discussed later in the paper.

This question of cumulative effects of stress is one that interests me very much, because in the everyday situation as distinct from the once-in-a-lifetime experimental set-up it seems to me to be the one that matters. It is after the one-hundred-and-ninety-ninth quarrel that the husband reaches for his hat or the wife for the return ticket to her mother. Let us look at some effects of cumulative stress on the variability of visual judgment of some members of aircrew subjected to repeated spells of flying in a large piston-engined aircraft with a deserved reputation for vibration and noise. These sorties involved inevitably some disturbance of the normal diurnal rhythm, and probably some loss of sleep as well as the other stressful factors.

Variability of judgment rises as we go from sortie to sortie. The overall trend is quite clear, although the differences do not become significant until the third sortie. Individual differences again are very marked, as is apparent from the considerable contribution to the variance of one subject who suffered from sickness on the third sortie, and this fact makes me rather cautious about generalising from this one experiment. But the data certainly fit our general framework of stress decrement.

Several of these experiments use performance of a vigilance task as a measure. Now vigilance, while not perhaps the primarily physiological condition of maximum efficiency hypothesized by Head, is certainly a very important factor in the individual's ability to interact effectively with his environment. In the changing and unpredictable situations, which constitute the warp and woof even of ordinary living, the ability to identify and respond to significant changes in the environment is of considerable importance. For certain jobs, such as mines rescue operations and air traffic control, it can be vital. So if we are able to show reproducible effects on vigilance of certain environmental conditions under an idealised laboratory situation this may have important implications for the real life task.

Let us consider next the effects of a certain range of ambient temperature conditions and physical work on visual vigilance. No signals were ever missed by any of the 72 subjects under test in the control condition, that is, when the subject was fresh at a normal comfortable room temperature and had not carried out any hard physical work. As the subjects are exposed progressively to higher temperatures (85 deg.—92.5 deg.) the number of missed signals increases. The total percentage of missed signals is not large but the deterioration is highly significant measured by the Poisson test. The importance of this falling-off in vigilance is that at some period during exposure to stress the subject is capable of missing an important and clearly discriminable signal for which he is waiting. It is perhaps not too fanciful to recall cases where a highly experienced man has missed a familiar signal right under his nose. For example, there is the case of the experienced engine-driver whose failure to perceive a warning signal caused a serious accident although the evidence showed him to have been keeping the normal look-out.

It seems clear enough from this evidence that this range of temperatures can reasonably be rated as comprising a stress condition. The next question is to examine the pattern of breakdown under stress to see if any systematic trends are evident. A graph has been prepared showing the percentage fall-off of a different group of subjects tested under conditions where the degree of stress could be systematically increased. It shows that as we increase the degree of heat stress (shown on the vertical axis) there is a continuous increase in the proportion of missed signals (shown on the horizontal axis). Unfortunately the stress conditions are not absolutely scaled, and it is not possible to fit a curve to the data. The proportional trends are however quite evident. Thus, it is clear that for exposure to increasing heat stress a systematic decrement in vigilance is apparent. If we now examine the effect of adding hard physical work to the heat stress we find that there is a dramatic increase in the number of missed signals in the heat + work condition as compared with the heat only condition. This difference is significant at the 2.5 per cent. level.

Next if we consider the time of exposure to heat stress we find that in the case of the 100 deg. F. temperature there is a sharp rise in the number of missed signals from zero to about 12½ per cent., approximately 20 minutes after entry to the heat chamber. Considering the 95 deg. F. temperature, we find that up to 25 minutes the percentage of missed signals is no higher than 2 per cent. Between 26 and 30 minutes after entry into the heat chamber there is a sudden rise to over 8 per cent. Comparing this data with the graphs of the first slide it seems possible that each of these variables, time, temperature and work, is exerting a progressive effect on vigilance decrement and that in the original Mines Rescue Experiment, breakdown of subjects' performance is due to the complex of variables operating.

So far we have considered only the missed signals in the task. If we now consider the time taken to respond to the significant signals we have a rather unexpected paradox. In the original Mines Rescue Experiment there was a sharp decrease in the speed of reaction under the 100 deg. F. (heavy work) condition and some evidence of a decrease in speed of reaction in the other conditions as compared with the control. In the second set of experiments however, there was no significant change in reaction time throughout all the heat stress conditions including the heat + work condition.

This paradox is not yet completely resolved. At the present moment the most likely explanation appears to be that a marked slowing up in reaction time occurs particularly under conditions of very hard physical work combined with a high degree of saturation—an experimental condition which could not be achieved in the second set of experiments. Nevertheless the disparity between the two findings coupled with the earlier evidence that reaction time in vigilance experiments tends to be much greater than the classical values make this result something of a problem to explain.

Two additional pieces of evidence may, however, help to elucidate the position. In a report published last year, I put forward the hypothesis that there are in fact two kinds of vigilance.

(a) Vigilance 1—which occurs when a subject is set to observe a very occasional signal during a long period of watch. In this case, we might expect the typical deterioration after half-an-hour and the greatly prolonged reaction times shown in the Clock Test experiments and the earlier work on the Cambridge Visual Vigilance Test.

(b) Vigilance 2—where the subject is set for a short period of observation, and the stimuli are presented at high speed and in comparatively large numbers. Here we might expect the small but finite and constant proportion of missed signals observed in the present investigation to occur with no significant change in the mean reaction time.

We know little as yet about possible underlying bases for these types of vigilance. But it may be that in Vigilance 1 there a cumulative and comparatively gross reduction in receptor-effector efficiency, and that the greatly increased reaction time is an index of this reduced efficiency. In the Vigilance 2 situation there may be a momentary failure on the part of the cerebral analysing mechanism, which is evidenced only by a small, constant probability of missing signals. It might not necessarily be shown in a mean reaction time score to observed signals, since the reduced efficiency is momentary and quickly made up again.

If this theory is tenable it should perhaps be possible to demonstrate an increased reaction time under heat stress when the subject is presented with a large number of signals in a comparatively short time, all of which must be reacted to. To test this a final experiment was set up where the subject was presented with a large number of stimuli in a short time (40 stimuli in five minutes in random order) and the mean serial reaction time before and during exposure to the most severe heat-less-work conditions of the series was calculated. There is a small, but statistically significant, rise in this serial reaction time from the control period to the first hour; and from the first hour to the second hour. It may seem surprising that such small differences should be statistically significant, but the standard error of the serial reaction time for a well-practised subject is remarkably small, about 0.0038.

The other important observation is that the data taken from the Mines Rescue Experiment referred strictly to the recovery period after exposure to the heat + work stress, since it was not possible to test the subjects in the heat chamber, whereas the data from the second experiment were obtained during the exposure to heat stress. In view of what has already been said about the effectiveness of interpolated tests it might seem curious that the test given during the recovery period appears to be showing much greater slowing up of reaction time. In actual fact, very little is known about performance during the recovery period after exposure to heat stress. But a set of experiments on which we are at present engaged may help throw some light on this problem.

First, I should like to compare the physiological pattern of breakdown under heat stress with the psychological one as evidenced by the data already given. In the case of the Mines Rescue Experiment already mentioned a set of tolerance times were drawn up on the basis of the physiological data and observers' assessment. These may be compared with a set of tolerance times suggested by the data obtained from the psychological experiment. The agreement is remarkably close, and it is likely that the similarity of the results using the physiological and psychological criteria is due in this investigation to the severity of the task.

However, when we come to consider the psychological and physiological patterns of breakdown under less severe conditions and also to examine the carry-over into the recovery period a substantially different picture emerges. In the case of the physiological data the criteria used alter almost from the beginning of the experiment, show a rise up to a peak point and then recover rapidly as the subject is removed from the stressful environment. In the case of the psychological data (the test used here was one which combined speed and accuracy of discrimination), we find a markedly different pattern. The subject has to undergo exposure to the heat stress for some considerable time before any change in response pattern emerges (compare this result with the earlier findings). After a certain time the first effects on performance become apparent. These increase with increasing deterioration under exposure to stress, and do not subside rapidly when the individual is removed from the stressful environment. In fact the effects on performance here may persist for several hours and even perhaps into the next test day. This is particularly marked in the case of the older subject.

Time does not allow me to go further into the pattern of the breakdown under stress but I can perhaps conclude by summarising some of the major points in the argument.

(a) It should not be assumed that any given set of experimental conditions is necessarily stressful as far as the particular activity under measurement is concerned. It is necessary to establish in some way that there is a definite probability of deterioration before the conditions should be called stressful.

(b) For different measures of performance the degree of breakdown under stress may differ very considerably. It should not be assumed, therefore, that because one measure fails to show decrement that another measure will be equally insensitive. In general, there appears to be good evidence that tasks involving a high degree of knowledge of results are less likely to suffer under environmental stress than tasks which involve little or no knowledge of results. Similarly a task which involves some degree of what I call 'internal' stress is more likely to show decrement as the result of environmental stress.

(c) In general, there may be considerable differences in the effects of stress on physiological and psychological criteria, although for conditions of extreme severity there may be some agreement in the pattern of changes.

(d) There is some evidence that the general picture of breakdown of performance under stress follows a definite pattern, although it may differ in details, irrespective of the nature of the stress.

(e) One of the most typical effects of working under stress, both internal and external, is an increase in variability of performance. This may often occur even where there is no apparent change in the mean level of performance.

(f) There is now some evidence to show that repeated exposure to environmental stress may build up cumulatively in the nervous system. As yet we have little information about the nature of this cumulative effect, but I consider it one of the most hopeful fields for a combined psychological, physiological and neurological attack on a problem of universal interest.

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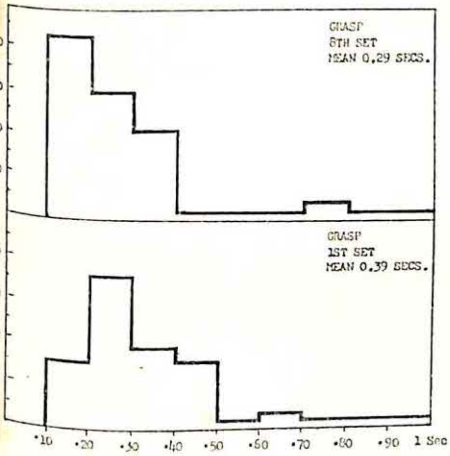
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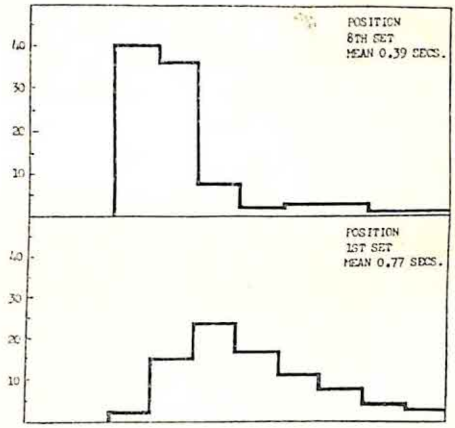
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Absence and Turnover in the Divisions of One Company, 1950-1955

By JOHN CROWTHER

A research project of the National Institute of Industrial Psychology, of which this study was a part, was sponsored by the Joint Committee on Individual Efficiency of the Medical Research Council and the Department of Scientific and Industrial Research, and financed from Counterpart Funds derived from United States Economic Aid.

GOING absent and leaving one's employment are forms of workers' behaviour which constantly exercise personnel departments. Not only are they costly to the employer, but they are widely held to be indicators of the state of affairs within the factory. Thus managers would be pleased to reduce high rates of either absence or turnover if they could. It is often tacitly assumed that indices of absence and separation will show a favourable response to changes which improve conditions of work or otherwise benefit workers.

To some extent both forms of behaviour are completely unavoidable—when due to death or severe illness, for example. In addition, different types of employee are known to have different rates of turnover and absence: unskilled workers have higher rates than skilled workers; those with shorter service contribute a larger share of turnover than those with longer service. To a further extent, therefore, the overall rates of the indices may be beyond the direct control of management. Thus, there is some limit to the extent to which management can reduce rates of labour turnover and absence. This study was carried out to discover precisely how the indices behaved over a period of time and to relate the changes to incidents which occurred at the same time.

In the company whose factories are the subject of this study a central personnel department supervises a standardized system of recording. Numerical data from each factory were easily available and, because the same methods of recording are used at each, it was possible to compare the levels of the indices at the various factories. All the data were treated so as to separate a trend from deviations which otherwise make the trend difficult to discern.

Ten factories and eighteen populations have been studied. All the factories employed over 500 men and eight of them also employed over 270 women. Eight of the populations were of over a thousand people of one sex.

The company provided the following data for each population:

1. Monthly records of the absence rate, defined thus:

$$\frac{\text{Number of days lost}}{\text{Total possible number of days worked.}}$$

2. Annual labour turnover records quarter by quarter, defined thus:

$$\frac{\text{Number of persons leaving during the quarter} \times 4}{\text{Average monthly strength during the quarter}} \times 100$$

3. Average size of the population during each quarter.
4. A 'diary' of events within each factory and its locality during the period.

In order to be able to study smooth trends of turnover, absence, population size and unemployment, moving average figures of each have been calculated quarter by quarter in the way shown in Table 1.[*]

Each quarterly figure (Column B, Table 1) is expressed as a logarithm. Each set of four consecutive figures in Column C is added (Column D). Each pair of Column D figures is then added (Column E), and these figures are then divided by eight (Column F). The Column F figures are the trend figures, quarter by quarter, and the deviations from the trend are obtained by subtraction of the trend figures from the original quarterly logarithms of Column C.

TABLE I: AN ILLUSTRATION OF THE METHOD OF CALCULATION

A	B	C	D	E	F	G
DATE	QUARTERLY L.T.O.	LOG. (COLUMN B FIGURES)	SUM OF 4 QUARTERLY LOGARITHMS	SUM OF 2 COLUMN D TOTALS	COLUMN E TOTAL ÷ 8	(COLUMN C) – (COLUMN F)
1950 1	44	1.6435			TREND	DEVIATION
2	54	1.7324				
			6.5950			
3	46	1.6628		13.3024	1.6628	0.0000
			6.7074			
4	36	1.5563		13.2622	1.6578	−0.1015
			6.5548			
1951 1	57	1.7559		13.1189	1.6400	+0.1159
			6.5641			
2	38	1.5798		13.5114	1.6889	−0.1091
			6.9473			
3	47	1.6721		13.9712	1.7464	−0.0743
			7.0239			
4	87	1.9395		13.9304	1.7413	+0.1982
			6.9065			

THE MOVEMENTS OF THE INDICES

Movement together of the labour turnover and absence trends of the separate populations

In the introduction it was hypothesized that both turnover and absence indices would respond favourably to improvements in the conditions of work: when they refer to the same population they should move in the same vertical direction over the same period. The extent of the movement may well be different for the two indices, because of the involuntary nature of some labour turnover and absence. In ten of the eighteen cases, labour turnover and absence trends showed a high degree of agreement. However, the patterns shown by all ten pairs were similar and were also similar to five of the remaining sixteen trends of turnover and absence. (This widespread pattern is that shown in Diagram A.) This is to say, the trends of turnover and absence did show a substantial degree of similarity in their behaviour. The fact that trends from many populations were the same points to a general cause.

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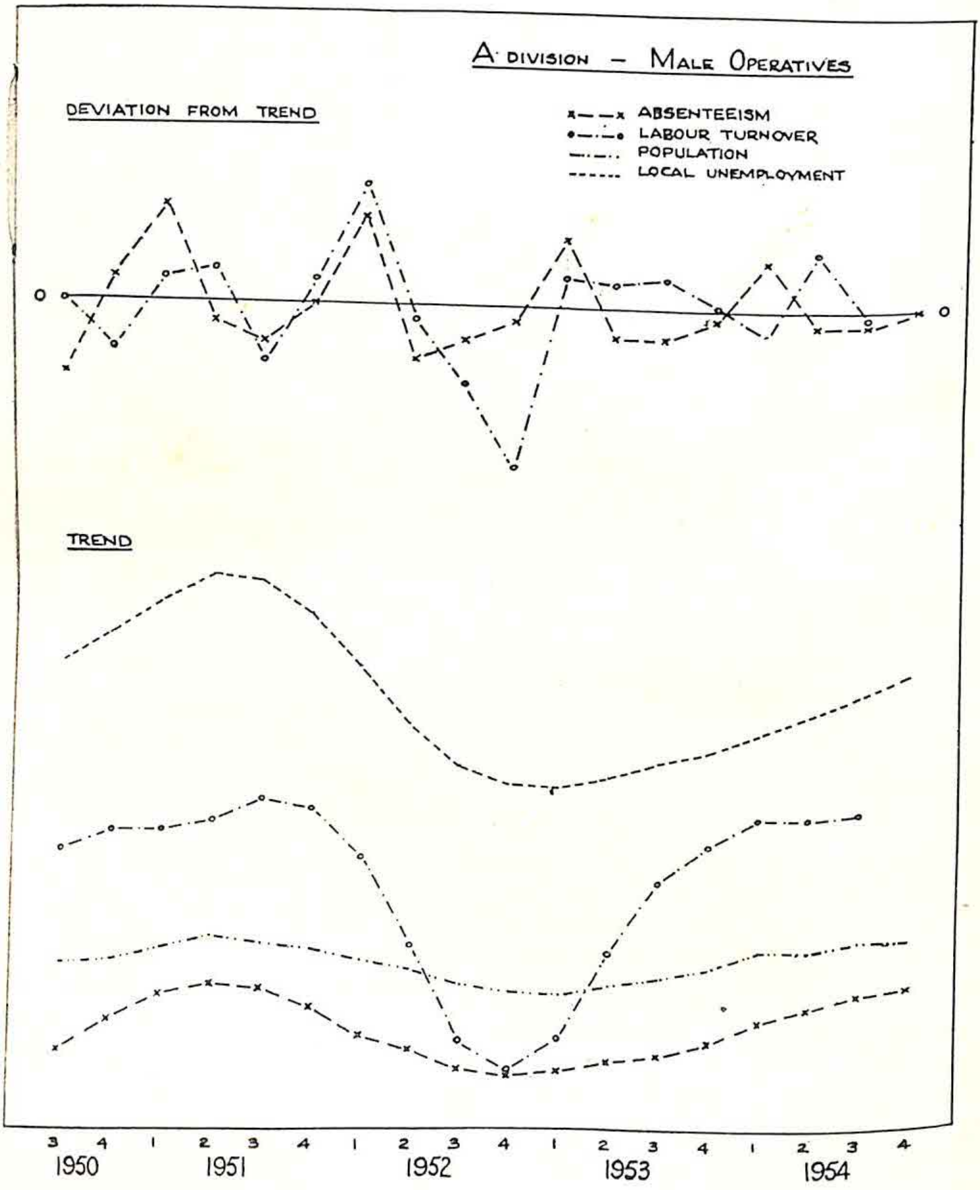
[*] The Institute is indebted to Dr E. C. Rhodes of the London School of Economics for advice on this method of calculation

DIAGRAM A.



Changes in the size of the population and their effect upon labour turnover

The relationship between length of service and labour turnover is well established. New entrants are more prone to leave than those with longer service. Thus, when a factory reduces the size of its population by not re-placing leavers—as this company widely did in 1952—the relationship will act so as to reduce labour turnover. This itself might have explained the behaviour of many of the labour turnover trends, including the majority of the cases which showed the general pattern. There are, however, three cases when the decrease of turnover occurred when the population size was nearly constant. In four more the decrease was accompanied by an increase in the size of the population. In these cases, and therefore probably in the others, some other factor was operating.

The tendency for movements of each index to be associated with the unemployment indices of their locality

In 1952-53 the number of unemployed people rose substantially. By the end of 1953 in most places the figure had been restored to its previous low level. In twelve of the eighteen cases there was close agreement between the labour turnover trend and the inverted trend of unemployment in the locality of the factory. In eleven cases there was a similar agreement between absence and unemployment. In the ten cases mentioned above where there was high agreement between turnover and absence, the inverted trend of unemployment closely matched the trends of the two other indices. Diagram A, for which the unemployment trend has been inverted, illustrates the relationship in these ten cases.

Clearly there was during the period under examination a close inverse relation between changes in the number of unemployed and changes in the turnover and absence rates in many of the populations. As unemployment increased absence and turnover fell; as it decreased again, absence and turnover rose. It must be concluded that the changes in absence and turnover between 1950 and 1954 were closely allied to changes in the amount of unemployment in the locality and to changes in the size of the population. This supports the findings of Drs Behrend and Long in their studies of absence and turnover (Behrend, 1951, and Long, 1951).

THE DIFFERENCES BETWEEN THE GENERAL LEVELS OF THE INDICES

Constancy of the relative order of factories throughout the period, as defined by their rates of labour turnover and absence

On Diagrams B, C, D and E are plotted all the trends of one index referring to populations of one sex. Visual inspection will show that the level of each trend line remained moderately constant in comparison with the levels of the others. The constancy was less than complete, but rank-order correlations show that for the labour turnover trends it was substantial — the correlations are all above 0.85. The graphs show that the absence trends were spread over a smaller vertical scale. Correlations, however, show that there was a good degree of constancy.

TABLE 2a: RANK-ORDER CORRELATIONS OF THE LABOUR TURNOVER LEVEL OF EACH FACTORY IN THE THIRD QUARTERS OF EACH PAIR OF YEARS.

		1951	1952	1953	1954
Men	1950	.97	.97	.94	.95
	1951		.94	.90	.93
(Ten factories)	1952			.93	.95
	1953				.99
Women	1950	.98	.85	.90	.91
	1951		.87	.95	.97
(Eight factories)	1952			.87	.87
	1953				.99

TABLE 2b: RANK-ORDER CORRELATIONS OF THE ABSENCE LEVEL OF EACH FACTORY IN THE THIRD QUARTERS OF EACH PAIR OF YEARS.

		1951	1952	1953	1954
Men	1950	.73	.57	.70	.83
	1951		.69	.79	.65
(Ten factories)	1952			.77	.50
	1953				.83
Women	1950	.90	.83	.81	.71
	1951		.98	.84	.76
(Eight factories)	1952			.83	.80
	1953				.95

The persistence of these constant levels over the five-year period justifies the use of the term 'general level' for any one factory of the group. The general levels of the trends contrasted one factory with another: the movements of the trends were common to many factories.

Agreement between the general levels of turnover and absence of each factory

Inspection of the trends of absence and turnover (Diagrams B, C, D and E, to be found at the end of this paper) will show that the same populations tend to appear at the top of both of the relevant diagrams. The same populations appear at the bottom of both also. There is one exception—Factory K—and both sexes at this factory were exceptional in having a high turnover rate and a low absence rate throughout the period. The correlations of Table 3 have therefore been calculated after Factory K had been excluded. No explanation of the exception has appeared.

Table 3 expresses the degree of agreement between the relative levels of turnover and absence in each factory. Actual numerical values of labour turnover and absence rates are of course of an entirely different size from each other, but in the circumstances of this study there was a high degree of agreement between the relative levels (i.e., the severity) of the two indices of a population.

TABLE 3: RANK-ORDER CORRELATIONS BETWEEN THE TURNOVER AND ABSENCE LEVELS OF EACH FACTORY.

YEAR	QUARTER	MEN	WOMEN
WHOLE PERIOD		.91	.79
1950	3	.80	.36
	4	.80	.51
1951	1	.94	.67
	2	.94	.67
	3	.98	.66
	4	.94	.71
1952	1	.94	.83
	2	.83	.96
	3	.82	.94
	4	.62	.91
1953	1	.70	.99
	2	.70	.88
	3	.88	.59
	4	.76	.51
1954	1	.81	.46
	2	.89	.39
	3	.84	.54

Unemployment and the general levels of labour turnover and absence

We have already noted the close inverse relationship which existed between changes in the number of unemployed in the locality of a factory and changes in the labour turnover and the absence rate of that factory. It might be hypothesized that there would also have been a close inverse relationship between the general levels of labour turnover or absence of a factory and the average proportion of the employable population who were unemployed. That is to say, that factories in areas where many workers were unemployed would have tended to have low rates of turnover and absence; that where few workers were unemployed the rates of labour turnover and absence would have tended to be high. This hypothesis was not borne out, the rank-order correlations between the general levels of either index and the average proportion of the working population in the locality who were unemployed ranging from 0.12 to −0.09.

To summarize, although fluctuations in the number of unemployed were closely related to fluctuations in the rates of labour turnover and absence, there was no relation between the general level of unemployment and the general level of labour turnover or absence.

CASE STUDIES

Factories A and K

The company has two factories in a northern town which make different products. The number employed at Factory A was reduced during 1952-53; there was no short-time working but overtime was curtailed. Factory K reported that 'hours worked have been fairly steady and weekly earnings have shown a gradual rise throughout the period'. Throughout the period the size of the population remained moderately steady, or increased. The state of affairs and the conditions offered to the employees were much better in Factory K than in Factory A during 1952, at least.

In spite of the better conditions in Factory K, both labour turnover trends followed the same pattern, which is that of the inverted unemployment trend for the district. (Factory A is illustrated in Diagram A.) Thus, in both cases labour turnover fell when unemployment rose and labour turnover rose when unemployment fell. It may be inferred that the changing proneness of employees to leave was related to the changing ease of securing jobs, which was the same for employees of both factories.

The absence curves of Factory A—but not those of Factory K—followed the turnover curves closely, although the fluctuations were smaller. The Factory K absence curves of both men and women, having fallen, remained at a lower level until the end of the period. Certain incidents are recorded in the 'diaries' which the Company provided and may help to account for this.

1. At the beginning of 1953, a medical check was introduced for all operatives applying for a job.
2. In October, 1952, a new toilet block and a canteen were completed. During 1953 colour schemes for machinery and service pipes were introduced.

Factory F

The trends of absence and turnover are very neatly matched with each other and with the local unemployment trend. The men's curves of absence and turnover start to fall at the beginning of 1954, unlike the women's curves or the curves of local unemployment. At about this date the male population trend stopped increasing, while the female population trend continued to increase. Another feature of the scene was the accumulation of the effects of several recent measures. These include the introduction of a cycle security scheme, the opening of a much appreciated new canteen, the introduction of tea-trolleys, the introduction of strip-lighting and new ventilation into the machine shop. In addition, some rehousing near a new industrial estate was progressing, rather more thorough selection methods were being used and a scheme for training recruits from outside the factory for production staff started in July, 1954.

Factory C

Factory C is in a town in which the chief industry employed more people in 1954 than in 1951; the demand for labour was greater in the later year than it was in the earlier. Factory C expanded steadily throughout the period, and the increased proportion of new employees will have acted so as to increase the labour turnover. In spite of this the trend did in fact decrease, and the absence trend did likewise.

In the second half of the period the labour turnover trends rose a little, but they did not reach their 1950-51 levels. The absence trends remained at low levels until the end of the period. The following incidents may have helped to counteract the greater demand for labour.

1. Departure of two militant shop stewards—April and December, 1953.
2. Strike of 40 electricians for two days. No result. July, 1953.
3. In May, 1955, there was a strike of about half the factory in connection with a dispute concerning holiday pay. No award was made.
4. Two new sports grounds were acquired in 1953-54. They were used mainly by apprentices.
5. A space heating system has been gradually introduced since 1952. Another factory block was acquired in 1953 and the labour force was able to expand.

Factory J

This factory was characterized by very low rates of absence and labour turnover. None of the trends accorded well with the general pattern. At the same time, the labour turnover deviations were sometimes substantial. Where the rates are low, chance separations become important, and this may help to explain the irregularity.

The employment situation of this factory was unusual. There had for a long time been a shortage of labour in the locality: the shortage of female labour was especially acute and some men had to be employed on women's jobs. The personnel of the factory were said to have a 'corporate feeling' and it was thought that working at one factory for a lifetime was characteristic of the district. In Factory J the average age of the women employees increased by one year in each year between 1950 and 1955. The factory also had the highest average age and length of service record of the Company.

SUMMARY OF THE FINDINGS

The trends of labour turnover and absence of the larger populations of one company showed a widespread tendency to follow the same path throughout the years 1950-1954.

A pattern of falling and rising turnover and absence coincided with a pattern of rising and falling unemployment in the locality and also with changes in the size of the population of the factories. These population changes imply changes in the proportion of employees with short service; the latter can be held directly responsible for some part of the fluctuation of labour turnover. The population changes and the changes in the unemployment situation were but two manifestations of the working climate of the period.

There was a tendency for the factories to be placed in the same rank order in terms of the severity of either turnover or absence, and for this order to persist throughout the period. Factories which had high turnover rates tended to have also high absence rates and to maintain these high rates from 1950 to 1954. There was one exception of a factory whose male and female populations maintained a high turnover rate and a low absence rate throughout. The rank order position of a factory was not closely related to the average proportion of the local working population which was unemployed during the five year period.

DISCUSSION

Four types of influence which may have affected those who made up the labour turnover and absence figures can be isolated. From the evidence which has been available in this study the details can only be inferred from the behaviour of the indices. First, the stability of the general levels of the factories over the period indicates that long-term characteristics fixed them. These were not entirely characteristics of the factories themselves, for the working traditions of the people in Factory J's locality were believed to contribute to the low rates shown there, and local characteristics may have been significant elsewhere. However, the important differences were probably the differences between the factories, the products, the conditions of work and the contentment of the workers.

Secondly, there were changes in the employment situation which have been manifested in this study by the changes in population size and in the unemployment rate. At the same time when these changes occurred the diaries referred to reduced production and reduced earnings. Exactly upon what information an employee decides whether or not to leave or go absent is uncertain. A clue lies in the fact that the threat of dismissal becomes harmless to the absentee in times of full employment. The availability of fresh employment therefore influences decisions about leaving and also about going absent, and it may usefully be considered to be paramount. We may now add the apparent ease of obtaining other jobs to the forces, listed at the start of this paper, which influence turnover and absence but lie beyond the control of management.

Thirdly, there were the brief incidents, mainly seasonal in nature, whose effect was to be sought in the deviations from the trends. Among these was the seasonal variation in health which produced the expected deviation in the first quarter of the year (see Diagram A). There was also a tendency towards a seasonal rise of labour turnover, which is more under voluntary control, and which is more rarely mentioned in the literature. It is interesting to notice that in many of the cases where there were indications of seasonal turnover variations, the pattern was distorted during 1952-53—the period of increased unemployment. This was not true of absence. Unsuccessful attempts were made to relate the quite large deviations, which occurred even in the larger populations, to incidents which would have a brief impact.

Fourthly, there were the incidents which were recorded in the diaries and which might have had a gradual impact. The case-studies of Factories K, F and C have listed incidents which may help to account for the shape of the trends, in particular where the shape cannot be accounted for by recourse to the changes of population size and unemployment. The wide occurrence in the trends of turnover and absence of a general pattern indicates the overpowering effect of the influences represented by the unemployment rate. If it had not been for the consequences which we have associated with unemployment it is possible that some changes of absence and turnover rate could have been related to changes within the factory. There were, however, no major changes of this kind during the period.

Just precisely what internal events can be associated with changes of absence and turnover must be the subject of another study. However, it is the sum total of such events which constitute the long-term characteristics of the factories. These, it is suggested, provide the contrast between the factories which was expressed in this study by their contrasting general levels of turnover and absence.

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DIAGRAM B.

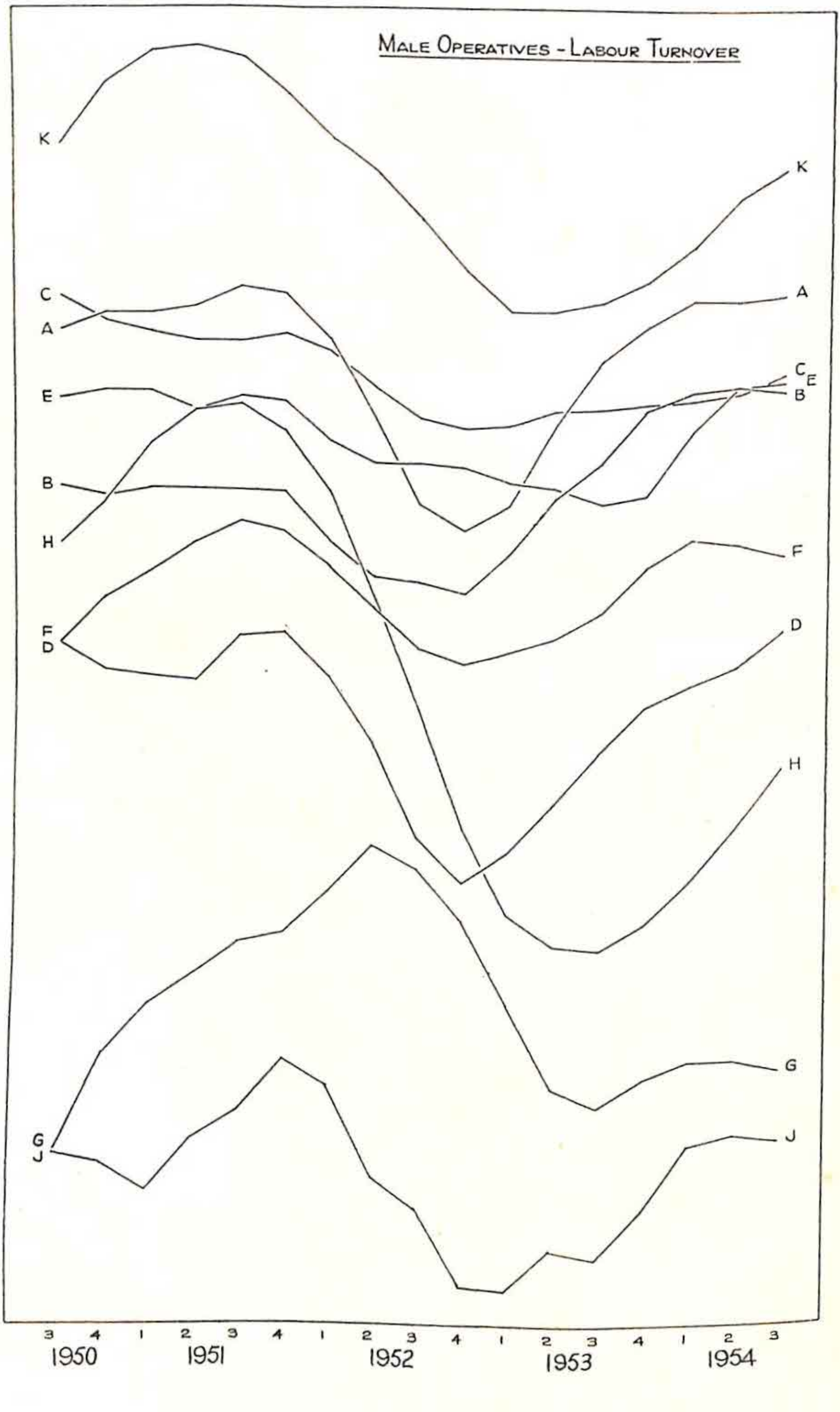
MALE OPERATIVES - LABOUR TURNOVER
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DIAGRAM C.

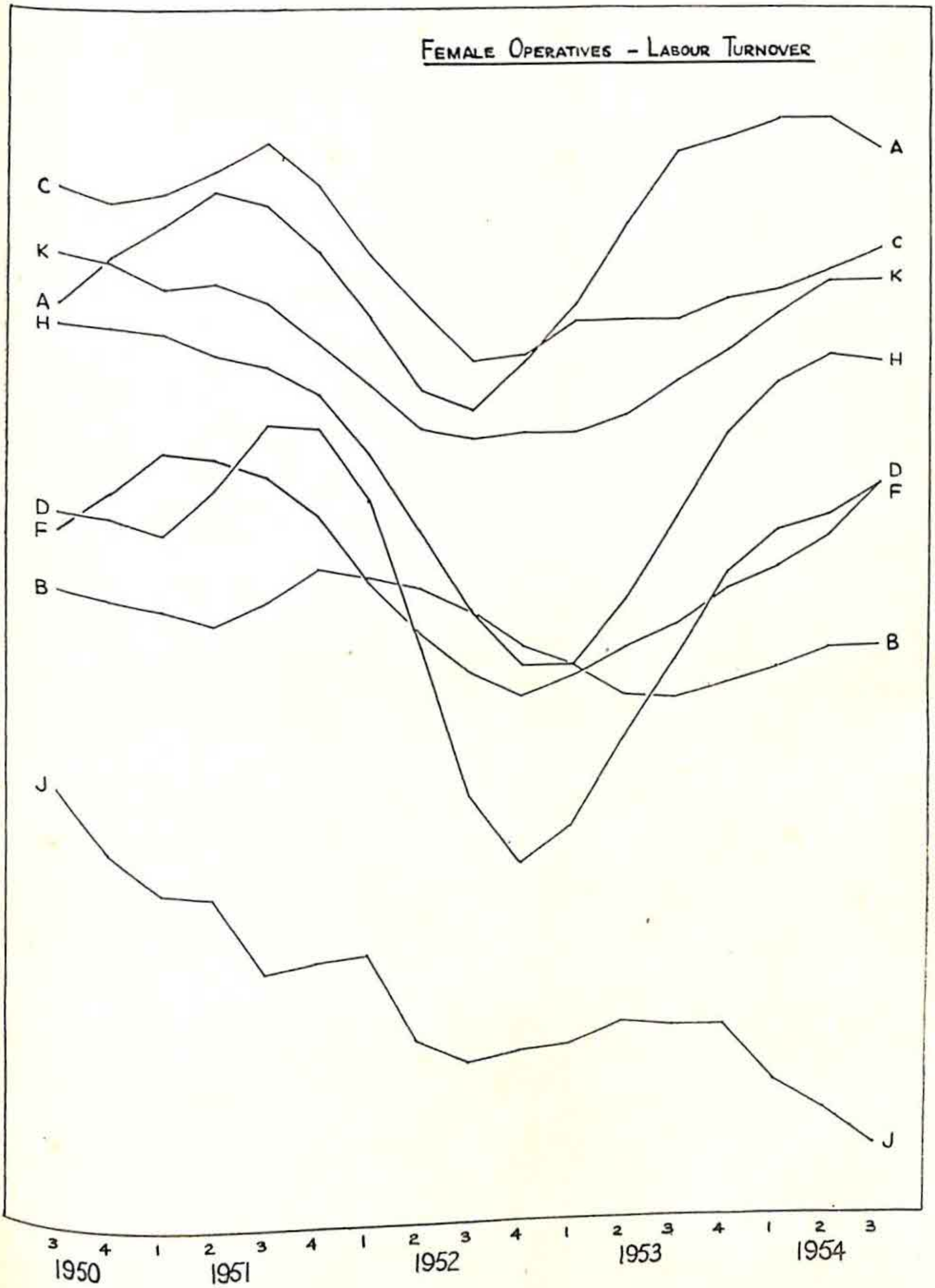
FEMALE OPERATIVES – LABOUR TURNOVER
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DIAGRAM D.

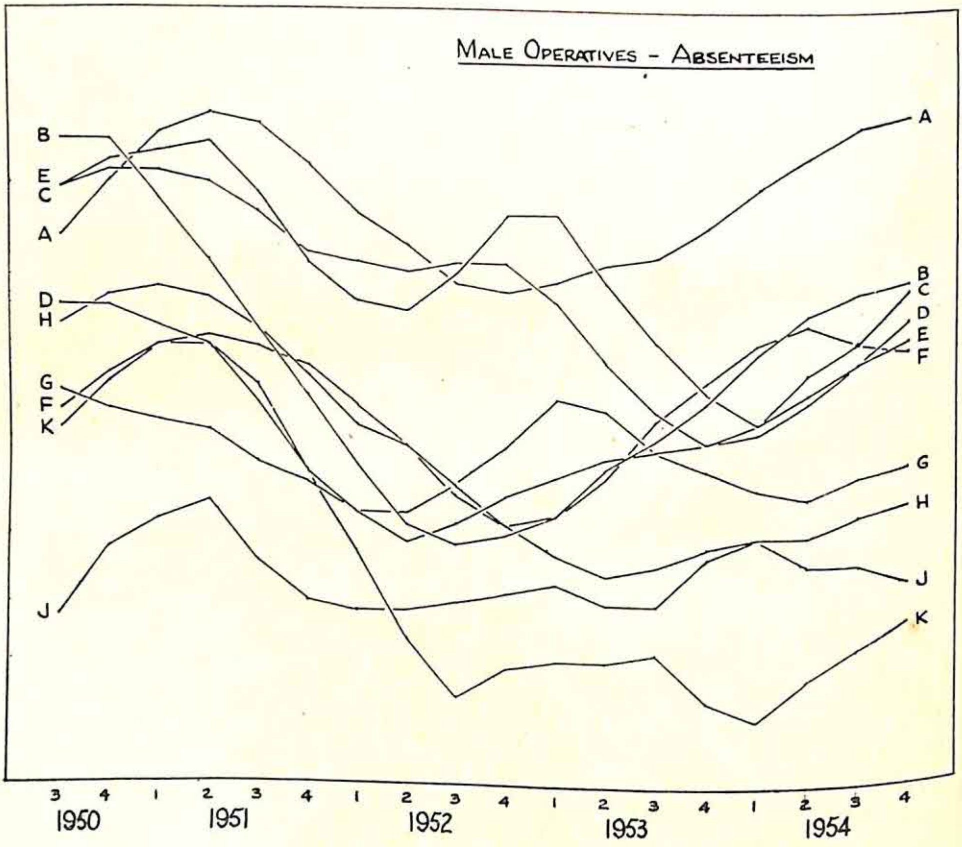
MALE OPERATIVES - ABSENTEEISM
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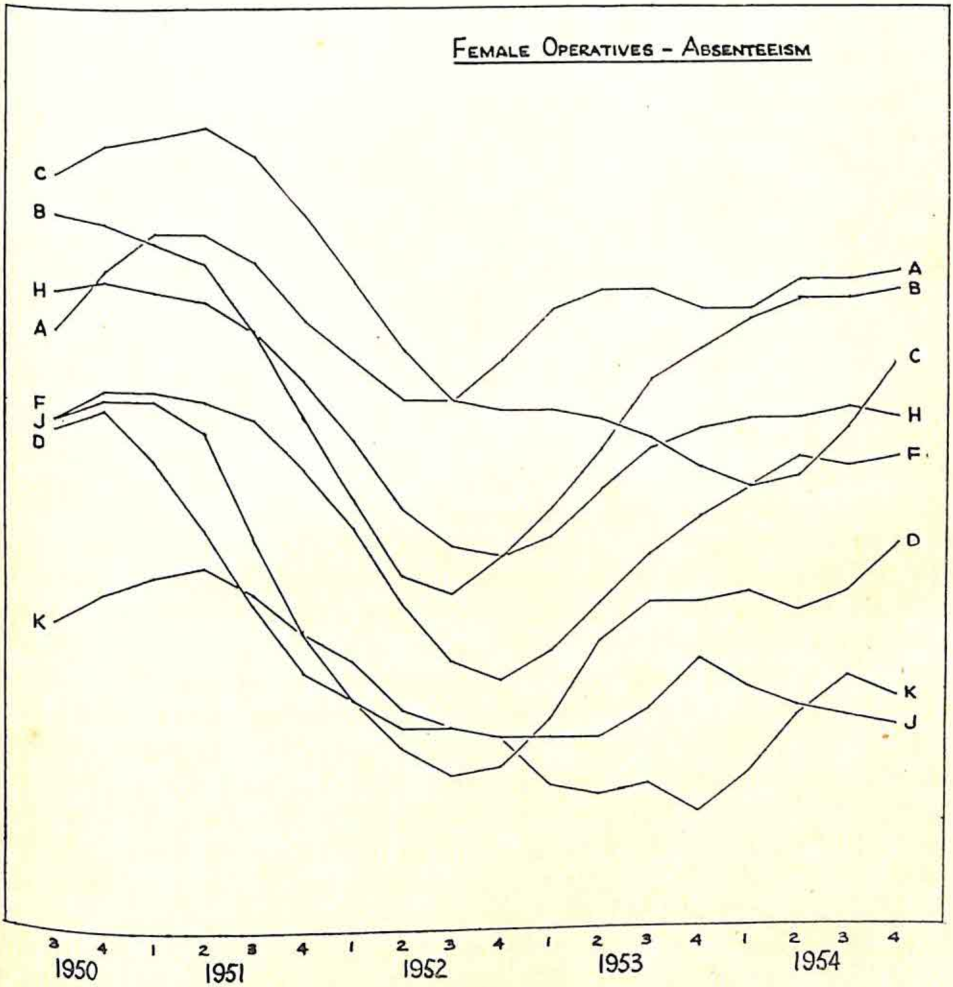
DIAGRAM E.


FEMALE OPERATIVES - ABSENTEEISM
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The Influence of Group Size and Stability upon the Effectiveness of an Incentive Payment System

By LESLIE BUCK

(From the Medical Research Council's Industrial Psychology Research Group)

INTRODUCTION

IT must be almost universal practice in industry for workers to be organised into groups, either to meet the requirements of the job, or, at all events, for the purposes of supervision and administration. The number of workers grouped together in one unit for these and other reasons varies considerably from industry to industry, from factory to factory, and even within one workshop in the factory. It is not unreasonable to suppose that variations in the size of a group may be related to variations in certain measures of performance and morale. In fact several investigators have recently shown, for example, that group size is a factor determining—or, at least, statistically related to—output level (Marriott, 1949), workers' understanding of and satisfaction with a group incentive payment scheme (Campbell, 1952) and non-sickness absence (Hewitt and Parfit, 1953). A more recent investigation has demonstrated that the size of group is related to the rate at which its productivity is increasing, and, further, that the stability of the group membership may also be a factor determining the value of this particular performance measure.

In most working groups one would expect to find that group productivity —that is, its output, taking account of the number of hours worked—will vary from week to week. Exceptions to this might be found where output is completely controlled either by the pace of a machine or assembly belt, or by rigid and systematic restrictions applied by the workers themselves, but otherwise weekly fluctuations in productivity are almost inevitable. Over a period, however, there may be a general tendency for productivity to change in one direction rather than another, and this tendency can be measured.* Measuring the rate of productivity increase over any given period is, of course, not the same thing as measuring the overall level of productivity for the period. It is quite possible for a group's productivity to be at a high general level, and at the same time for it to be increasing at a low rate. Conversely a group having a low level of productivity may have a high rate of increase. In fact if changes in productivity were to follow the classical logarithmic learning-curve, a group's circumstances would change from the latter state to the former.

Interest in the rate of productivity increase as a measure of performance arose from the aim for which the investigation was being made. This study was part of a research into factors influencing the effectiveness of incentive payment systems, and its especial concern was to consider some of the factors involved in the use of group incentive schemes (Shimmin, Williams and Buck, 1957). Exactly what should be understood by the effectiveness of an incentive payment system—what constitutes effectiveness, and hence how it should be measured—is a matter of some dispute. It depends perhaps on what one hopes to get out of it. The view taken here is based upon the function of an incentive as defined in a recent paper by Sylvia Shimmin (1955). According to the author "incentives refer to objects in the external situation whose function is to increase or maintain some already initiated activity either in duration or intensity". If productivity is regarded as a measure of the duration and intensity of activity, then the influence of an incentive should be seen in the increase, or at least the maintenance, of productivity, and the effectiveness with which it fulfils its function will be shown by the rate at which productivity is increasing. A comparatively high rate of increase will indicate an incentive which is more effective than one where the rate of increase is zero. In other words, when productivity is going up the incentive is fulfilling its function more adequately than when it is only being maintained. When productivity is falling, it is clear that the incentive is comparatively ineffective, and might even be a deterrent to work. Rate of productivity increase provides therefore a measure of incentive value, and gives a basis for making comparisons between various situations.

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*The statistic which serves this purpose is the linear regression coefficient of productivity on time. The value of this coefficient in any specific case, is the amount by which productivity is tending to change each week. When the coefficient is positive, it indicates a change upwards, but a negative value indicates a tendency for productivity to fall. When, in spite of fluctuations, the tendency is for productivity to remain at the same level, the coefficient will be zero.

DESCRIPTION OF THE FACTORY

The investigation was carried out at a British Railways Carriage and Wagon Works where rolling stock was sent for servicing and overhaul. Four gangs of coach bodymakers and their apprentices, employed on repairing the bodywork of passenger carriages, worked in one large workshop under the supervision of one foreman, each with its own chargehand who was also a member of the gang. The gangs were differentiated on the basis of the kind of work done by each. Thus gang B dealt with all the articulated stock and some non-articulated carriages, whereas gang A worked on non-articulated stock only. Since the main difference between these two types of stock was one of undercarriage rather than superstructure this did not amount to a great deal in terms of coachbody work. Gang D dealt with carriages requiring only light repairs, that is comparatively little work on the one carriage, so that its work was rather more superficial than that of gangs A and B. Gang C, working on the heating and seating of carriages subsequently passed on to A and B, did work which was perhaps most unlike that of the other gangs. Even so the similarities of the work done by all four gangs on the same restricted range of vehicles were much greater than the differences.

The workers were paid on a group piecework system. For every job completed the appropriate piecework price was credited not to the worker who had done it, but to his gang's pool of piecework earnings. The total piecework earnings for the week represented therefore the amount of work done in that time, and, assuming that the prices had been set fairly in the first place, the work done by each gang could be compared by comparing their piecework earnings. Such a comparison, of course, would not take account of differences in the man-hours worked by each gang in order to produce that amount of work. This could be done by calculating the timework earnings due to the gang according to the individual members' base rates and hours of work. The ratio of piecework earnings to timework earnings provided a measure of the amount of work done in the time taken, that is, it was a measure of rate of working or productivity. This ratio, known as the piecework percentage, was used by the firm, and is used here, as a measure of productivity. The workers also were conversant with it, for it was used in the sharing of the piecework earnings between the members of the gang. Individual payments were made such that the ratio of piecework to timework earnings was the same for each gang member and was equal to the piecework percentage for the whole gang. In addition each worker received cost-of-living and overtime allowances based on hours worked.

This brief account of the gang and payment systems has perhaps made clear in passing what is meant in this context by a working group. It is a group of workers in a recognised geographical location, under the supervision of one chargehand, doing the same work, and dependent upon each other for their weekly wages. As far as doing the work was concerned, it would not be true to say that every member was in equal contact with all the others. It was usual for them to work together on one job in small face-to-face groups of perhaps two, three or four men. However, these small groups were interchangeable in membership and, in all gangs but D, were in close proximity to one another. Perhaps the two factors which were of greatest importance in defining the gang were the chargehand, by whose name it was known, and the piecework percentage.

One other feature of the situation must be mentioned before passing on to a consideration of the results. In February, 1950, the wage provisions of the Railway Shopmen's National Council Minute No. 577 were put into force. This was known popularly as the 577 award, and its avowed intention was to increase the incentive to work by modifying the payment system, and hence to increase wages and productivity. As far as these four gangs were concerned the award meant, in effect, that piecework prices—and thus all piecework earnings—were increased to 139 per cent. of their old values, and base rates—and thus all timework earnings—were increased to 163 per cent. of their old values. Therefore, in order to make valid comparisons between the pre- and post-change productivity figures, all the earlier ones had to be reduced by 139/163 or 0.853.

RESULTS

1. *Group size.*

The size of the group was measured by counting the number of names on each gang's weekly paybill, which gave the number of workers sharing the piecework earnings for the week. Weekly paybills were inspected covering the six years 1949 to 1954, a total of 303 working weeks, of which

56 preceded the 577 award and 247 followed it. The number in each gang was by no means constant, but throughout the period the four gangs remained in the same relation to each other. Gangs A and B were the two larger gangs with almost the same number of workers in each; gang C was next with somewhat less than half the membership of A and B; and gang D was the smallest with almost half that of gang C. This relation is evident from the mean sizes for either period before or after the 577 award, or the whole six years together, or the means for the bodymakers alone excluding the apprentices. Gangs A and B were large and very much alike; gangs C and D were both smaller, but not to the same extent.

TABLE I: MEAN NUMBERS OF WORKERS.

GANG	BODYMAKERS AND APPRENTICES			BODYMAKERS ONLY OVERALL
	BEFORE 577 AWARD	AFTER 577 AWARD	OVERALL	
A	39.9	41.0	40.8	29.2
B	37.6	39.4	39.1	27.4
C	15.5	16.1	16.0	13.8
D	9.7	8.8	9.0	6.7

2. *Group stability.*

Changes in the amount of work supplied to each gang necessitated transfers of bodymakers* from one gang to another. This factor, together with the engagement of new and the retirement of old workers, coupled with casual and sickness absence, led to some instability in the membership of the gangs. The degree of instability is indicated to some extent by the number of workers entering and leaving the gang each week for any of the reasons mentioned. Such a measure, however, does not take account of how long a worker had remained a member of the gang before his membership had been terminated. This is an important consideration, for such changes that did occur may have involved mostly workers of short membership, leaving members of longer standing undisturbed. That situation would be different from one where terminations involved equally workers of all periods of membership. For this reason a record was made of each separate period of gang membership, unbroken by either transfer or absence, that fell within the six years 1949-1954. There were 560 discrete periods, many more than the number of bodymakers since the majority had served more than one period in more than one gang. In Table 2 they have been grouped into four categories (based on the quartiles of the total distribution) but in all the gangs they ranged over the entire scale of from 1 to 303 weeks. The cases at the high end of the scale represent the bodymakers who had spent the whole of the six years working in the same gang without a break. The table

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*The apprentices, who were moved from gang to gang in a more or less systematic fashion during the course of their training, have not been taken into account in considering group stability.

TABLE 2: DISCRETE PERIODS OF MEMBERSHIP TABULATED ACCORDING TO LENGTH: NUMBER IN EACH CATEGORY.

GANG	WEEKS				TOTAL
	1-5	6-15	16-50	51-303	1-303
A	46	44	46	50	186
B	56	55	56	45	212
C	53	9	7	20	89
D	42	10	8	13	73
TOTAL	197	118	117	128	560

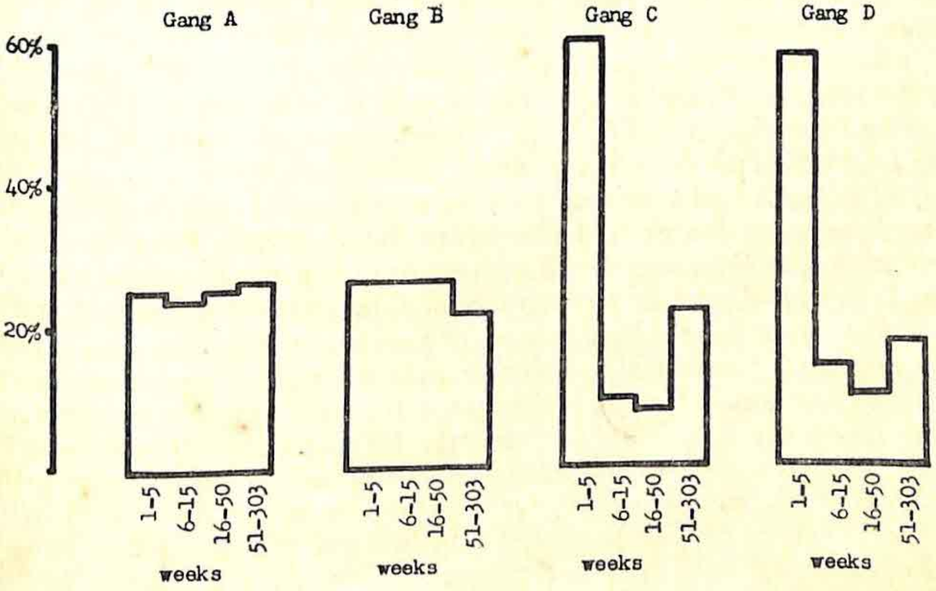
shows marked differences between the gangs in respect of their patterns of membership. The entries differ significantly from contingent frequencies calculated from the totals for rows and columns ($\chi^2 = 63.3$, $P < 0.001$). Gangs A and B had almost the same total number of periods and these were distributed equally among the four categories, but in gangs C and D there were comparatively few in the middle categories. In the latter pair the tendency was for a period of membership to be of either a month or less or a year or more, unlike the former pair where this differentiation could not be so easily made. The particularly high proportion of short periods in gangs C and D indicates also that when a membership period ended for any reason it was most likely that of a bodymaker who had been a member of the gang for only a short time, whereas in gangs A and B it could with more equal probability have been one whose length of membership fell into any of the four categories. These differences between and similarities within the pairs are clearly illustrated by Figure 1.

The differences in gang stability so far considered are qualitative rather than quantitative. The use of length of membership as a quantitative measure of stability is complicated by the fact that, because of the shapes of the distributions, the overall mean length of membership is inadequate for the purpose. A clearer picture of the situation can be obtained by considering the shorter membership periods (1-50 weeks) of each gang separately from the longer periods (51-303 weeks). Table 3 shows the total man-weeks accounted for by (a) the shorter, and (b) the longer periods, the proportions that each represented of the gross total for (c) all periods, and also the mean lengths of the periods. The shorter membership periods of gangs C and D, although being proportionately slightly more numerous, at least in gang

TABLE 3: NUMBER OF MAN-WEEKS WORKED BY THE FOUR GANGS.

GANG	MAN-WEEKS		MEAN LENGTH OF PERIOD
	NUMBER	PERCENTAGE	
(a) Short membership periods (1-50 weeks)			
A	2039	23	15.0
B	2490	30	14.9
C	460	11	6.7
D	409	20	6.8
(b) Long membership periods (51-303 weeks)			
A	6822	77	136.4
B	5810	70	129.1
C	3720	89	186.0
D	1632	80	125.5
(c) All membership periods			
A	8861	100	47.6
B	8300	100	39.2
C	4180	100	47.0
D	2041	100	28.0

FIGURE I. DISCRETE PERIODS OF MEMBERSHIP TABULATED ACCORDING TO LENGTH: PERCENTAGE IN EACH CATEGORY.



D (Figure 1), accounted for smaller percentages of the gross membership measured in man-weeks. Furthermore, their mean lengths were very much shorter. The numbers of bodymakers serving these periods are shown in Table 4, together with the mean total number of weeks served by each (that is, ignoring the breaks between separate periods served by the same worker). Here again the means are much smaller for gangs C and D. For the longer membership periods the situation was almost the reverse: in gangs C and D they accounted for larger percentages of the gross membership (Table 3(b)), and the mean total number of weeks spent in the gangs by the bodymakers concerned were larger (Table 4(b)). The only exception to the reversal was gang D in which the mean length of the longer periods was not greater than those of gangs A and B, as was the case with gang C. But comparing the mean lengths of longer and shorter periods for each gang, the ratios between the two were very much greater for both gangs C and D than they were for gangs A and B. It would appear therefore that gangs C and D were each composed of a hard core of long service bodymakers accompanied by a peripheral membership of workers whose length of service at any one time was very much shorter, but in gangs A and B this differentiation was much less prominent. The fact that the long service bodymakers of the former pair accounted for higher percentages of their respective gross memberships (and, it may be inferred, were responsible for proportionately higher amounts of the work done) suggests that these two gangs may have had the higher degrees of stability. On the evidence, however, it is better to describe the differences in qualitative rather than quantitative terms.

TABLE 4: NUMBER OF BODYMAKERS WHO HAD WORKED IN THE FOUR GANGS.

GANG	NUMBER OF BODYMAKERS	MEAN NUMBER OF WEEKS PER BODYMAKER
(a) Short membership periods (1-50 weeks)		
A	51	40.0
B	47	53.0
C	30	15.3
D	18	22.7
(b) Long membership periods (51-303 weeks)		
A	37	184.4
B	32	181.6
C	16	232.5
D	8	204.0
(c) All membership periods		
A	68	130.3
B	59	140.7
C	42	99.5
D	22	92.8

3. *Rate of productivity increase.*

The third variable measured was the rate of increase in productivity. Eight values were computed, one for each gang in each period, and of these eight only one was found to be statistically non-significant. The exception was gang D in the pre-577 period, whose rate of increase was, to all intents and purposes, zero. But in each of the other seven cases it can be taken that, in spite of week to week fluctuations, there was an overall tendency for productivity to rise by so many percentage points each week.

TABLE 5: RATES OF PRODUCTIVITY INCREASE.

GANG	PIECEWORK PERCENTAGE PER WEEK		
	BEFORE 577 AWARD	AFTER 577 AWARD	DIFFERENCE
A	0.081†	0.045†	−0.036
B	0.065†	0.049†	−0.016
C	0.030*	0.063†	+0.033*
D	−0.007	0.069†	+0.076†

* differs significantly from zero at probability level of 1%
† differs significantly from zero at probability level of 0.1%

The rate of productivity increase was different for each gang, and here again it was found that the gangs fall into the same two pairs. This was most evident in the situation as it was after the wage award where gangs A and B on the one hand, and gangs C and D on the other, had almost identical rates of increase. The position was not quite so clear cut before the award, but even so the pattern was there, and significance tests for inter-gang differences bring it out. Furthermore, it is also evident when making the comparison between periods rather than between gangs. In the cases of both gangs A and B the post-award rate of increase was lower than the corresponding pre-award figure. The differences, however, were not statistically significant so that it must be concluded that for each of those gangs productivity went on increasing at the same rate after the change as it had before. But with gangs C and D the differences were in the other direction, and they were significant, so that after the change productivity was going up faster than it was before.

RELATIONS BETWEEN VARIABLES

The variables were related by comparing the orders of the gangs ranked in respect of each. With only four gangs to be considered nothing was to be gained by computing rank correlations, and the comparisons were made by straightforward inspection. Such correlation as was found by this method was made more significant by the fact that the gangs fell into the same two pairs on all three variables.

1. *Size and stability.*

The observation that the two larger gangs possessed a pattern of membership stability which was different to that of the two smaller gangs suggests that particular stability patterns might be associated with different gang sizes. In gangs C and D, however, the similarities in stability were not matched by similarities in size, one being only half the size of the other. Furthermore, although gang D occupied the extreme position on the size scale in relation to gangs A and B, it was gang C which occupied the extreme position in respect of stability, judged by the criteria of the data in Tables 2, 3 and 4. In view of this it seems that the two factors were, to some extent at least, independent of each other, and should therefore be dealt with separately when considering possible determinants of the rate of productivity increase.

2. *Size and rate of productivity increase.*

The four gangs stand in the same relative position to each other on both variables: the rank order in each case is A B C D. In respect of rates of productivity increase, however, the actual order from high to low was completely reversed. Thus gang A which had had the highest rate of increase, subsequently had the lowest; gang D which had previously had the lowest rate, subsequently had the highest; and the other two gangs reversed places so that the four gangs retained the same positions relative to each other. There was no corresponding reversal of their rank orders in respect of mean size. This means that whatever might be said about the relation between the two variables before the award, will be the exact opposite of what might be said for the situation after the award. Overlooking this observation for the moment, it is clear that the rank orders for the two variables correspond perfectly, and also that the gangs fall into the same two pairs. The correspondence is most marked in the period before the change when the not unsubstantial difference between gangs C and D in respect of their mean sizes, was accompanied by a difference in rate of productivity increase. But even after the award, the rank orders were identical, and the pairing of the gangs was evident. One other point which can be made about the relation between these two variables, is that the order of the gangs ranked according to the differences between the pre- and post-change rates of increase also corresponds to the order in respect of mean size.

3. *Stability and rate of productivity increase.*

The method used to assess gang stability was not quite so simple as that used for measuring size, and it was not possible to obtain separate assessments for the two periods before and after the wage award. It is necessary to assume, therefore, that the situation as it appeared for the six years taken as a whole was true for the two shorter periods taken independently. This assumption can be made with the greater confidence for the period after the award, which represents the larger proportion of the total. It is in this period that is found the closer relation between the gangs in respect of the two variables, and the correspondence is made closer still by the fact that the gangs fall into the same two pairs for both. In the pre-change period, where the assumption about the gangs' relations to each other in respect of stability is not quite so tenable, the assumed similarity between the stabilities of gangs C and D is not matched by a similarity between the rates of productivity increase. Nevertheless the relation holds good for gangs A and B, and overall there was some relation between the two variables even if it was not so marked as in the post-change period.

DISCUSSION

The evidence of these results suggests that a relation existed between the size and stability of each gang and its rate of productivity increase. The differences and similarities between the gangs' structural characteristics were matched by differences and similarities between their rates of increase. As far as the four and a half years following the 577 wage award are concerned it can be said that productivity was going up in the gangs of smaller size and particular pattern of stability faster than it was in the other gangs. At the same time it is clear that precisely the opposite statement was true of the situation immediately before the award. This presents a difficulty for, unless some satisfactory explanation of this reversal can be given, the evidence must be judged to be contradictory, and no definite conclusion can be reached.

The rate of productivity increase for each gang was measured under the assumption that it remained constant throughout the period under consideration. With the data dealt with here this proved to be a reasonable assumption.* Nevertheless, it would be unreasonable to suppose that this would hold good for an indefinite length of time—to suppose, in fact, that a gang's productivity would go on increasing at the same rate for ever. There must come a time when it would start to level off, when the rate of increase would decrease, and when productivity would become more or less constant. This can be predicted if only because the workers must eventually reach the physiological limit of their rate of working. It may take a long time to reach—but how long would depend in part on how fast productivity was increasing in the first place. A gang with a high rate of increase would reach the limit, and so reduce its rate of increase to zero, before a gang with an initially low rate of increase. The result of a comparison between two such gangs would depend upon what part of the total period was inspected. This makes explicable what happened in this situation. The period immediately before the wage award represented a time when gang D, with its high initial rate of increase, had reached its maximum and had found a more or less constant level. This level was presumably a psychological maximum rather than a physiological one since gang D subsequently increased its productivity beyond this limit. Gangs A and B with low initial rates of increase were still pressing on to some unattained limit. Consequently at this time their rates of increase were higher than that of gang D. Gang C was in an intermediate position. The period immediately following the wage award represented a new initial situation. The small and stable gangs were increasing their productivities at rates determined by their structural characteristics, and not inhibited by the fact that they had reached their psychological limits of productivity. Consequently their rates were higher than those of gangs A and B who were impeded by their large size and pattern of stability.

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*The four post-change regression coefficients yielded in analysis of covariance F ratios ranging from 356 to 2543. The F ratio at the 0.1% probability level with (1,245) degrees of freedom is not more than 11.38.

If this interpretation of the results is correct the conclusion is that productivity will increase at a higher rate in gangs of a small size and particular pattern of stability provided that such gangs have not reached their maximum levels of productivity. The position as it existed after the wage award represents the uninhibited state of affairs. It also follows from this interpretation that one effect of the 577 wage award was to release the gangs from their psychological limitations. This was clearly so, for whereas before the award gang D had reached, and gang C was reaching, maximum levels of productivity, after the award they increased their productivities beyond those limits. Gangs A and B, on the other hand, which had not reached any such limit, continued to increase their productivities at the same rate, neither slower nor faster. Exactly how the changes involved in the award succeeded in doing this, is another matter, but the evidence suggests that such did, in fact, happen.

In conclusion reference must be made to the implications of these results in terms of the original purpose of the investigation. If, as it is claimed, the incentive value of a payment system can be measured by taking the rate of productivity increase, the effectiveness of a group incentive payment scheme must be related to the characteristics of the group to which it is applied. A payment system can be applied to several groups at once, but the adequacy with which it performs its function will not necessarily be equal for all the groups. It is not sufficient that the system should itself be sound in structure and faultless in operation—the total situation in which it is operated must also be taken into account—and two particular points to be noted are the size and the stability of the working group.

ACKNOWLEDGMENTS

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Book Reviews

Company Executive Development Schemes. London: Management Publications Ltd., 1957. Pp. 164. Price 10*s.* 6*d.*

Alec Rodger's three criteria for effective *selection* procedures—technical soundness, administrative convenience and political defensibility—apply equally well to effective *training*, at whatever level. A training scheme must have the backing of a proper training policy; it must take into account that trainees may have to be released from their primary and more important jobs; and above all, it must be based on a study of what training is needed, how it can best be put over, and how its effects can be assessed. If the last point is neglected, a training course may include a lot of unnecessary material, involve faulty methods or merely perpetuate errors. In practice it is remarkably difficult to validate a training scheme, but without some attempt to gauge its effectiveness, training can do more harm than good. This applies particularly to Management as opposed to operative training, simply because such skills as can be taught are vague and nebulous, and the emphasis is inevitably on 'development' rather than on mastering a technique.

For some time there has been a need for a book which would describe some of the many attempts made by firms in this country to establish and validate management training schemes. This book is, at any rate, a beginning. It was compiled as a result of a survey of management training schemes in 112 companies in the North-West of England. (This geographical limitation does not apply to the descriptions of 13 training schemes which make up over 80% of the book, for they include those of firms in such places as Newcastle-upon-Tyne and Peterborough.) The work was carried out by a sub-committee of the British Institute of Management Educational Committee, with the help of the Manchester College of Technology.

The survey is not fully representative, as it was restricted to firms employing over 500 people (although two of the firms whose training schemes are described in full employ only half that number). A more serious criticism, which the compilers of the book are the first to point out, is that the impression given of the training schemes is very one-sided and limited to the views of top management. For example, on page 7 we are told that in 78 firms out of the total of 112 who were investigated, "the interview was actually given by the Chairman of the Company, by a director (usually the managing director) or by the general manager". As the report says later (page 14), "In the great majority of cases the investigator was most cordially received by members of higher management who gave generously of their time, but in practice there was a limit to his freedom to cross-examine". What sort of a picture of management training can be got from a survey of that kind? Apparently, if the training scheme looked all right on paper it was "accepted as fulfilling requirements for purposes of the survey". By 'looked all right' is meant that it satisfied the sub-committee's criteria of what constituted a good training scheme.

These criteria are worth quoting: "For the purpose of the survey a firm shall be classified as possessing a 'management training scheme' *if it gives systematic and conscious thought to*: (*a*) Assessment of managerial requirements (short and long term); (*b*) Sources of recruitment and methods of training; (*c*) Mechanics of training." (The italics are the sub-committee's, not mine; still, the use of the word 'conscious' is intriguing. Could we have systematic and unconscious thought?) These criteria are described in some detail, and are ones with which few would quarrel, except over one point. Many items are included under the heading 'mechanics of training' whose value has still to be shown because no-one has conclusively demonstrated whether they are good methods of training or not. What we need to know is whether, *e.g.*, special assignments, works visits, discussion groups, observer roles at management committees, special handbooks and reading lists, and attendance at outside courses are effective methods of training managers or not. The book can give us no help here; there are two short paragraphs which touch on turnover and the progress of trainees, but there is no mention of any systematic attempts to validate the methods of training. This, to some extent, increases the one-sidedness of the book, as the criteria could be held to be too subjective.

The 13 descriptions of Company Training Schemes are full and informative, although many of them read like standard company handouts, and include material (*e.g.*, on joint consultation and company history) whose relevance to the title of the book is hard to determine. But what is encouraging, despite any comments that can and should be made about validation, is the enthusiasm shown for management training, not only among large firms of international repute, but also among smaller ones who have far less facilities and opportunities. (The report suggests that 36% of the 112 firms had a training scheme in the sense defined.) It is also cheering to see that all the 13 firms who are studied in full make use of systematic interviewing, based on the 7-point plan. Few, apparently, make use of tests, relying on inferences about intelligence level based on "academic achievement, experience and reaction during the interview", a method well known elsewhere to be fallacious.

The most useful part of the book is the summary of the information provided by the 13 firms whose training schemes are given in full, in particular the 'conclusions' on pages 21-3. These lay stress on the need to have a senior executive responsible for a management training scheme; on the importance of the scheme being widely known throughout the company and providing ample opportunities for promotion from within; on the necessity for all managers to become proficient in coaching and instructing; on the value of learning by doing; and on the necessity for integrity by higher management in implementing the firm's training policy. The short chapter which embodies the summary and conclusions is the best in the book and justifies what at other times seems rather a fuss about nothing.

This book will be useful to anyone who has to plan a management training scheme. It will remind him that support for training must come from the top and that training needs to be well planned. He may get some useful ideas from the larger studies of individual firms, but he would be well advised to remember that what has worked in one firm may not work in another, and that unless some effort is made to determine what is reliable training and what is not, much other effort may be wasted.

T. M. HIGHAM

Nonparametric Statistics for the Behavioral Sciences. By SIDNEY SIEGEL. London: McGraw-Hill, 1956. Pp. xviii+312. Price 49*s*.

This is an excellent book. It meets a long-standing need in what appears to be the best possible way. The title says exactly what the book contains, and from cover to cover (and including the covers) it is possible only to find cause for praise of the highest order. Inside the cover pages — on the fly sheet — your reviewer was immediately impressed by a brilliant classification of the statistical tests to be discussed in the book. This classification alone is a valuable contribution to the understanding of nonparametric statistics. It shows the various tests of significance and measures of relationships for different classes of data and different types of problem or design, and how these relate to each other. Types of data are considered in terms of 'levels of measurement', whether nominal, ordinal or interval, whilst significance tests are headed, one-sample, two-sample and k-sample; correlation is classified separately from significance. (Perhaps this will help students to avoid the frequent confusion.) Each item in the classification chart is referenced to the page on which it is discussed.

The first three chapters provide a short and up-to-date summary of the problems of design and the choice of tests in the field covered. The student is introduced to the power function of tests by page 10. But, despite this apparent sophistication, no special training in mathematics is necessary to read and understand the work. This first introduction to the power function is amplified by chapter 3, where the problems in the choice of tests are further considered, together with questions of transformations. This chapter closes with a summary of the pros and cons of nonparametric statistical tests.

Chapter 4 begins the discussion of methods, and considers one-sample tests. This chapter and the remainder which consider methods, are set out in a user oriented systematic manner, as follows:

- i. Function and Rationale of Test.
- ii. Method.
- iii. Example (set out in model form).
  - a. Hypothesis.
  - b. Test chosen and why.
  - c. Significance level.
  - d. Sampling distribution.
  - e. Rejection region.
  - f. Decision.
- iv. Special cases.
- v. Power/Efficiency of test.
- vi. References.

Each chapter ends with a general discussion of the tests presented. Perhaps a haphazardly selected quotation might best show how clearly and in what way these summaries are made. "X^2 tests are insensitive to the effects of order when there is more than one degree of freedom, and thus X^2 may not be the best test when a hypothesis takes order into account. The Kolmogorov-Smirnov test should be used when one can assume that the variable under consideration has a continuous distribution. However, if this test is used when the population distribution is discontinuous, the error which occurs in the resulting probability statement is in the 'safe' direction (Goodman, 1954). . . . It has already been mentioned that the Kolmogorov-Smirnov test treats individual observations separately and thus does not lose information because of grouping, as the X^2 test sometimes must." These and other such forthright statements are most valuable. It may not be too much to hope that, if this book is widely read, we shall see some of the more powerful but less well-known tests used where they ought to be used. In all cases where it is applicable, the Kolmogorov-Smirnov test is the most powerful goodness-of-fit test available at the moment.

The remaining chapters are arranged systematically from the one-sample cases mentioned above, on to the two related sample cases, two independent sample cases, k related samples, k independent samples, and finally measure of correlation. The classification into separate chapters of related and independent samples is an excellent safeguard against a common confusion.

Even those in the behavioural (and doubtless other) fields who are already familiar with the tests discussed in this book might none the less do well to read it, if only to clear their minds of some elements of confusion which will almost certainly be present from the reading of previous text books. The tests covered are: the binomial test, X^2 one-sample test, the Kolmogorov-Smirnov one-sample test, one-sample runs test; the McNemar test for the significance of changes, the sign test, Wilcoxon's matched-pairs signed ranks test, the Walsh test, a randomization test for matched pairs; the Fisher exact probability test, X^2 test for two independent samples, the median test, the Mann-Whitney U test, the Kolmogorov-Smirnov two-sample test, the Wald-Wolfowitz runs test, Moses test for extreme reactions, a randomization test for two independent samples; the Cochran Q test, Friedman's two-way analysis of variance by ranks; the X^2 test for k independent samples, and extension of the median test for k samples, the Kruskal-Wallis one-way analysis of variance by ranks; the contingency coefficient, Spearman's rank correlation, Kendall's rank correlation, Kendall's partial rank correlation, Kendall's coefficient of concordance. The book ends with 21 tables related to the tests described. Many of these tables are difficult to trace in any other source.

It is to be hoped that we shall soon see similar user oriented texts covering other areas of statistical methodology. There is much information scattered throughout the literature which needs to be evaluated, classified and related to other work. Siegel has done an excellent job in the limited field he chose. Let us hope that this work sets a new fashion in statistical writing.

LESLIE T. WILKINS

Patients and Doctors. By KENNETH WALKER. London: Penguin Books, 1957. Pp. 182. Price 3*s.* 6*d.*

Mr Kenneth Walker's readable and thoughtful reflections are well known to most professional people and a wide lay public. He is thus a very suitable person to have written this book for the Pelican Series. It is primarily designed to explain to the layman something of the background of medicine and so of the doctor; with the hope that a greater understanding will lead to better doctor-patient relationship. Mr Walker feels this has deteriorated since the Health Service came into being. In this context even more might have been said of the present difficulties under which the General Practitioner works, and we really find less about him than about the specialist. Nonetheless, the book will perform a useful service here, and is something all doctors could recommend to their patients as light reading. It could also be recommended to most doctors, for the author does not hesitate to castigate their omissions and errors, and to remind us all of the needs of the patient as a person as well as the possessor of a disease.

R. F. TREDGOLD

The Practice of Psychiatry in General Hospitals. By A. E. BENNETT, EUGENE A. HARGROVE *and* BERNICE ENGLE. Berkeley: University of California Press (London: Cambridge University Press), 1956. Pp. xviii + 178. Price 30*s.*

The National Health Act was the first major step in this country toward the integration of psychiatry into the general body of medicine; but the administrative integration it produced has been prevented from having its full effect by the fact that psychiatric patients for the most part are treated in large mental hospitals, remote from centres of population, to which it is in fact illegal to admit patients suffering from maladies other than psychiatric disorders. The Lunacy Act at present provides the main impediment to the integration of psychiatric and general medical care for it also places legal obstacles in the way of the treatment of many psychiatric patients in general hospitals since the latter are not 'designated' under the Act for the treatment of patients 'of unsound mind'. If and when action is taken to give legal force to the reforms recommended by the Percy Commission these impediments will disappear and we may expect a considerable development of psychiatric sections in general hospitals. Ultimately this may reach the scale laid down by the U.S. Veterans' Administration which devotes 20 to 30 per cent. of its general hospital beds to the treatment of psychiatric patients. Whatever the extent of the development that takes place, the trend is clear. The general hospital of the future will certainly have a psychiatric section.

A book on this topic is therefore needed by all who have the responsibility for planning and administering our general hospitals, whether they be physicians or laymen. The book under review contains much valuable information on the architecture and staffing of such units, on the types of patients who can be treated in them and the means of treatment available. It has, however, two faults.

Firstly, the British reader will frequently find that the influence on the contents of American views, on matters ranging from psychiatric practice to the organisation of medical care, will affront his own prejudices on these subjects. The British psychiatrist, for instance, will read with some alarm that "every psychiatric ward should have a closed section with no intercommunication with the open section except through a specific avenue well guarded by locked double doors", and that "all windows, and this means not only the windows in patients' rooms and hallways but also in all other small service rooms, should be adequately barred".

The book's second fault arises from its multiple authorship which leads one chapter to contradict what has been said in another; but this fault has its beneficial effect for it is reassuring after the passages quoted above to read the view of Professor Ewen Cameron in the section on the "Day Hospital", who writes: "All who have worked both in a maximum-security, locked hospital and in open hospitals can have little doubt that many of the more difficult problems are created by the methods used in handling patients. . . . The stripping down room, the protected window, the counting-in and counting-out, the continuously watching attendant and nurse—all must conspire to convey to the patient the anticipation that what the group now expects of him is uncontrolled, irresponsible, impulsive and destructive behaviour."

The book has its good points, among which Professor Cameron's section is outstanding, but these are offset by other sections in which the conception of a psychiatric hospital displayed is not one I would wish to see adopted by the Boards of Governors and Management Committees of the general hospitals in this country.

G. R. HARGREAVES

Migration and Mental Disease: a Study of First Admissions to Hospitals for Mental Disease, New York, 1939-1941. By BENJAMIN MALZBERG *and* EVERETT S. LEE. New York: Social Science Research Council, 1956. Pp. x + 142. Price $1.50.

This book has an important bearing on one of the general problems of relating various deviations to particular areas, that is, to the ecological approach. It examines in detail the question whether the greater incidence of mental disease in migrants is the effect of their new situation and the stresses involved, or whether there is initially a great degree of mental disorder among persons who migrate.

In New York it was found that rates of first admissions to mental hospitals were much higher for migrants than for non-migrants, the differential frequently exceeding one hundred per cent. Not only was this true for psychosis as a whole, but also for its analysis into different types or classes. The subjects included both international and inter-state migrants, and the rates for natives born outside the state were far above those for persons born and residing in New York State. The incidences among foreign-born international migrants were in general intermediate between those for persons born in the State and those for inter-state migrants, and were usually close to the former.

Up to this point the sole criterion for distinguishing migrants from non-migrants had been place of birth, but the authors then took into account recency of migration. Results indicated clearly much higher rates of disorder among the more recent migrants than for those who had had greater time to adjust to new conditions. The timing of migration could therefore safely be considered an important factor in the relative rates.

Concerning the question *why* rates of first admission are higher for migrants than for non-migrants, it seems likely that three factors might be relevant: first, the possibility of selection in the place of origin; second, the stresses of migration and readjustment which must follow; and third, the possibility that differences might exist in the prevailing rates of mental disease in the originating and New York populations. On *a priori* grounds the authors tend to discount the third factor, and believe that a combination of the first two might account for the differences found. This was a well-controlled pilot study but, as the authors indicate, the results cannot necessarily be generalized until other researches in different places and times have been carried out.

A. D. B. CLARKE

Psychology of Personal and Social Adjustment. By HENRY CLAY LINDGREN. New York: American Book Company, 1953. Pp. x + 481. Price $4.50.

Although written in part as a textbook for a General Education course, this book is undoubtedly largely designed as a source of personal help to students for a wide range of everyday practical and emotional problems; as a kind of 'adjustment primer'. Its main principles of behaviour are described as 'dynamic', which means here that all behaviour is regarded as caused and purposive and that always the total organism is involved, and often, too, the social nexus in which the behaviour occurs. The basic approach can perhaps be illustrated best by indicating that the first two chapters are concerned with the self and unconscious processes, and that rather frequently a piece of deviant behaviour is explained in terms of a need for punishment: thus even the gambler, it is suggested, may be so motivated since he must, unconsciously, expect to lose. However, each chapter of the book is well supplied with suggestions for further reading (with a note on each book listed) and these quite often include books of a different approach.

Emotional problems of a personal kind are not the sole preoccupation of this book. Problems of social living are included—group processes such as leadership, social class and communication. Three chapters are concerned with aspects of employment and vocation. The first of these opens with a discussion of the place of work in our system of values and then describes typical sources of good and bad adjustment in employment situations. The other two chapters are concerned with choosing a vocation; the study of the self and the study of occupations. A lively feature of these, and other, chapters is a number of short case studies illustrating critical reasons for failure and maladjustment.

The book's illustrations include a series of amusing and pertinent cartoons. Although some of the practical advice given refers to American institutions, many a student in this country would profit from this book. THELMA VENESS

Other Books Received

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